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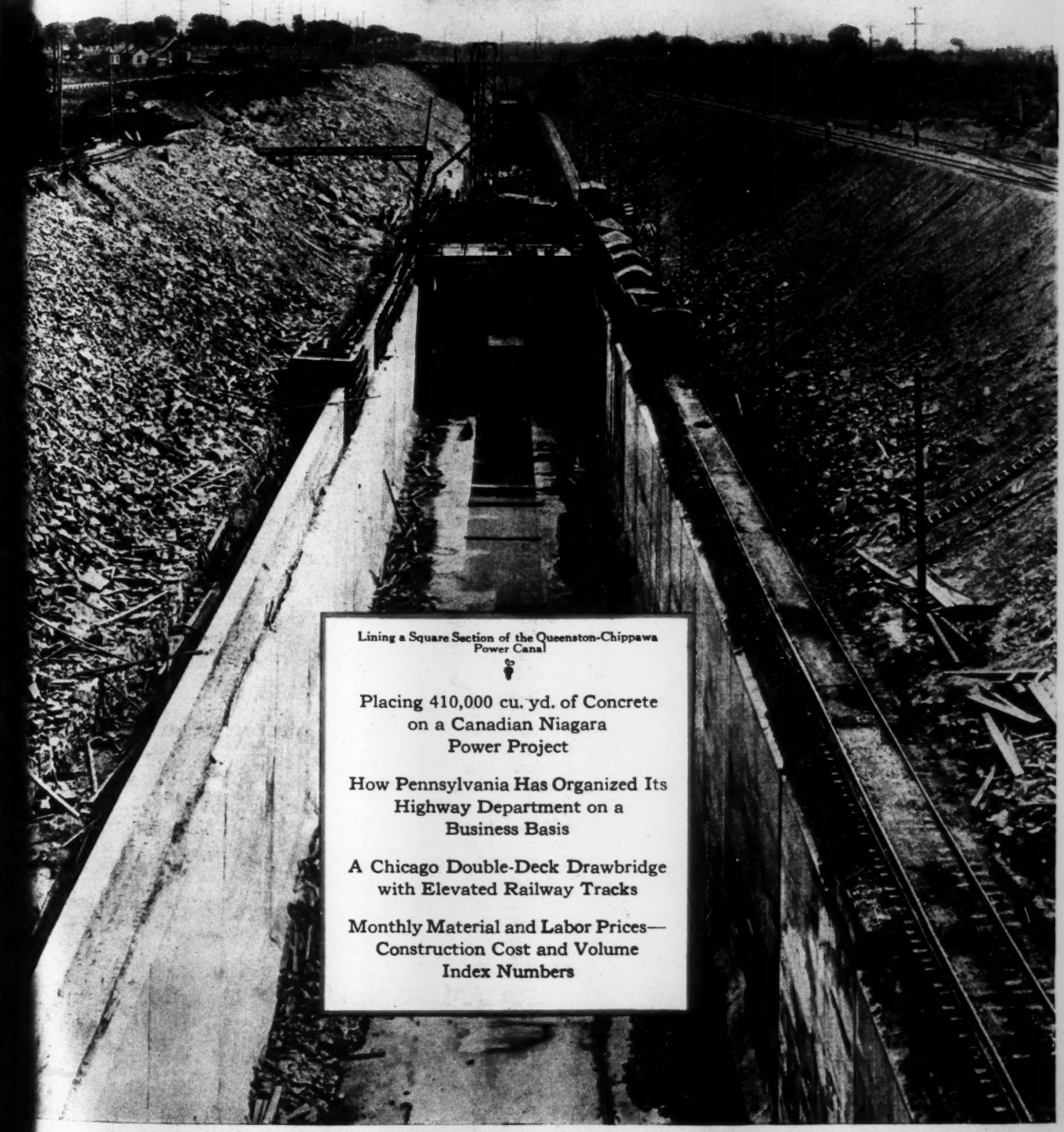


Lining a Square Section of the Queenston-Chippawa Power Canal

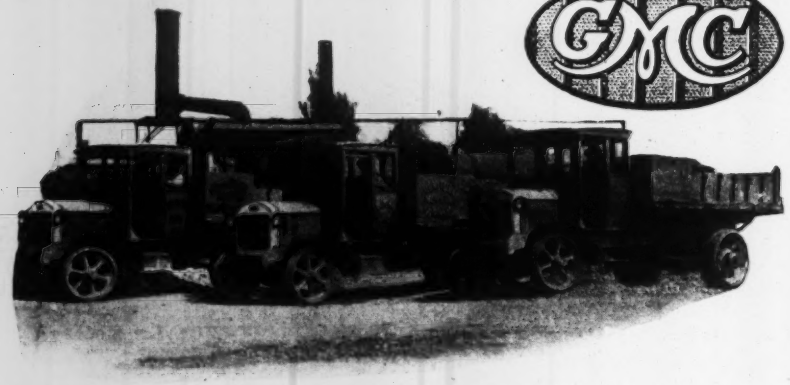
Placing 410,000 cu. yd. of Concrete on a Canadian Niagara Power Project

How Pennsylvania Has Organized Its Highway Department on a Business Basis

A Chicago Double-Deck Drawbridge with Elevated Railway Tracks

Monthly Material and Labor Prices—Construction Cost and Volume Index Numbers

General Motors Trucks



GMC Truck fleet operated by Mr. J. Sercombe, of Toronto, Canada

Speed and Power Make These Trucks Return Profits Every Day

We will all agree that there isn't much about a load of dirt that bears association with a load of furniture. That is, there isn't to most of us. But when Mr. J. Sercombe of Toronto, Canada, thinks of one he naturally considers the other. For both have an equal place in his business.

In the spring and summer when contracting work is going on in his community, Mr. Sercombe uses his GMC trucks seen in the photograph above for hauling dirt and contracting supplies. But instead of laying his trucks up when the season is over he keeps them in profitable service hauling furniture.

Meets All His Needs

While he agrees that the conditions under which his GMC trucks must operate in these two distinct lines of work are vastly different, he is very enthusiastic over their performance. They have all the stamina and power for the gruelling tasks which they are put to hauling contracting supplies, climbing out of excavations, and traveling rough, muddy roads and at the same time they possess ample speed for quick deliveries over smooth roads which is so necessary for long distance furniture moving.

It is evidence of this kind that proves beyond all claims that we could make that, regardless of how difficult or unusual your delivery or hauling problems may be, the GMC will handle them satisfactorily, economically and dependably.

Built for Hard Work

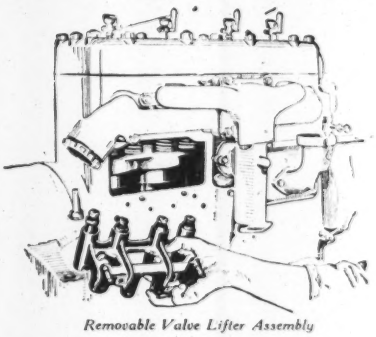
You have only to inspect a GMC to appreciate the reason. First of all you will note the unusual sturdiness of its construction. In every part of its chassis there has been embodied a surplus strength over and above its rated capacity. This is one of the reasons you will find a GMC always on the job day in and day out regardless of how severe the work or how difficult the traveling.

You will further agree that the GMC engine was designed with a practical knowledge of present-day hauling needs. It gives you all the speed you could wish for and so often need for quick deliveries over smooth roads and at the same time all the power necessary for traveling over rough or muddy roads and up steep grades. For the GMC two-range transmission, an exclusive feature which is standard in all GMC models of two-ton capacity and greater, has one range for speed and one range for power—all at the same engine speed.

Yet there is nothing complicated about GMC construction. Every effort has been made to simplify its design, eliminating the annoyance of the minor inconveniences which are experienced with most motor trucks.

Easy to Care For

There is another big advantage in the fact that there is not a single wearing part in the GMC engine which cannot be replaced. These units have been so designed that they can be quickly and inexpensively removed for replacement or adjustment without disturbing the other units with which they function. As for example, take the GMC valve lifter assembly shown on this page. By simply taking out four cap screws the entire assembly can be removed. This makes it possible to replace a worn roller or



Removable Valve Lifter Assembly

tappet in a few minutes. It also provides easy access to the crank case for the inspection of the connecting rod bearings without having to remove the oil pan.

As a consequence of this and many other such advanced engineering features as removable cylinder walls, pressure lubrication, dual cooling system, superheated carburetion and a positive speed governor, the GMC owner, whether he is operating one or a fleet of trucks, finds it a simple matter to keep them in first-class condition and in continuous profit-paying service at a surprisingly low maintenance expense.

Send for our special booklet describing the entire GMC line, including models from one to five tons capacity which have been reduced to prices which make them just as economical to buy as to operate. No obligation; just address—

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

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A Step Forward

SO ENGROSSING has been the difficult problem of making a living in these years of war recovery that the average man has rather lost his appreciation of the great things that are being done not only to prevent a similar visitation on his descendents but to make it more easy for him to get back to a normal way of life. The Senate's ratification of the naval and Pacific treaties are accepted, therefore, too much as a matter of course. In reality these treaties are landmarks in the progress of mankind toward mutual understanding—the triumph of common sense over killing competition. They are not perfect—so few human things are and so difficult it is to agree as to perfection—but their acceptance by the United States is the first necessary step toward putting together the shattered pieces of world economics.

An Invalid Industry Runs a Fever

IN SOME phases of the coal strike the consuming public is not interested. It cares nothing, for example, about the check-off practice or the factional proclivities of union leaders. In others it has the vital interest of a party, even though "of the third part." It wants plenty of coal at a fair price, it wants the miners as part of itself to earn a decent living, and it wants the operators to earn a reward for their enterprise that will insure a continuing development of the industry along constructive lines. At the roots of the controversy lies overexpansion. There are too many mines. The industry, moreover, is divided against itself; some mines are unionized, some are not. The non-union mines are fixing the price and getting the business and the non-union miners at a lower wage are earning more than their union brethren. The operators contend that war-wages must go. The miners cannot see this and insist that while prices should come down economies must be sought elsewhere, in profits for example. The public maintains that the war is over for the coal business as well as for the rest of us and that war-wages, war-profits and war-prices all must go, and go for good. This, however, is but the dispute of the day. However it may be settled the coal business evidently is a sick business which needs a thorough overhauling in the interest of miner, operator and consuming public. It will be cured only by the application of economic and social principles and not by its exploitation in the interest of industrial politics.

Wet-Batch Haulage Safe

CRITICISM of central mixing and wet-batch haulage as a method of concrete road construction is based on the opinion that hauling injures the mixture. No quantitative determination of the injury is ever cited nor is its nature ever clearly defined. A general charge of segregation or of loss of strength because of incipient hardening is ordinarily the extent to which injuries are particularized. Both segregation and loss of strength are logical possibilities of wet-batch haulage and examples of both can be named by anyone who has observed central-plant-mixed concrete road operations in any number. There is nothing constructive in reporting them as faults—it gets nowhere toward the solution of the real problem which is: Where does safety end and danger begin in hauling wet batches, for the method often offers economies in road construction and merits employment within the zone of safe operation? Tests have to be made whose results will measure the kinds of mixtures which can be most safely hauled, etc., before it can be asserted or denied that wet batch haulage is a safe and desirable road construction method. The Bureau of Public Roads tests summarized in this issue are an attempt to arrive at precise measures. In the preliminary conclusions there is assurance that central mixing and wet batch haulage, as now practiced, may *safely* be continued as a road construction process until the completed investigations disclose what ultimate refinements are required.

Map Questions

BY AND LARGE engineers are the principal map-using class. They are the people most directly concerned in the matter of how our maps are made—except perhaps the general public, whose wishes and needs are rather undetermined. Questions such as that of scale, discussed on p. 572 of this issue, reduce in the last analysis to the question of what is best suited to engineering service, at least in so far as topographic maps are concerned, which are used almost exclusively by technical men. Recognition of the engineering interest in mapping was the motive that led a group of engineers some years ago to call the government's attention to the backwardness of our federal topographic mapping work, and to urge that more systematic effort be made to carry it toward completion. Out of the action of this group, there resulted the formation of the interdepartmental Board of Surveys and Maps that is at present endeavoring to improve the federal mapping. Of the two lines along which this board has worked, centralization of all government mapping in one bureau, and standardization of methods used by the various bureaus, the former is perhaps chiefly of administrative interest. Standardization of mapping methods, however, is of public interest, and thus a matter that concerns engineers more than the departments themselves. It would be desirable if the questions of method coming before the board could be placed before the engineering profession of the country for discussion and expression of choice. There has been some attempt to provide for this by the creation of an advisory council to the board, made up of representatives of various technical societies. More direct opportunity of the engineering profession to participate in the deliberations is to be desired. The presentation of the discussion of scale supplies one opportunity of the kind.

Highway Department Organization

PREMISING that highway improvement is a continuing business Pennsylvania has developed a noteworthy organization to direct its state roadwork. The theory of organization and the distinguishing departmental practices are outlined in this issue. They are notably not the things commonly considered in discussions of state highway department organization. It is possible, indeed, that to most highway commissioners, educational supervision, co-ordination, separation of planning from performance, reward according to performance and positive financial control, are merely resounding phrases. They are actualities to the engineer; they need to be made realities to state road officials.

Conception of state highway improvement as a business enterprise established on a continuing basis is only gradually creeping into the thinking of highway officials. This is most true, of course, of the states in which departmental control of roads is new or where substantial expenditures for road improvement have been only recently possible. Road engineers generally have a fair understanding of the essential business character of highway improvement; political commissioners have some comprehension of the fact, and the road using and taxpaying public is supremely ignorant. This is a condition that cries louder at the present moment for change than any other thing in highway development. Too many state highway departments, given millions to work with, are being organized more like a committee to spend a fourth of July celebration fund than like the directing personnel of a business enterprise. A radical reform is necessary. Pennsylvania experience helps to indicate its direction.

Outstanding in this experience is the fact that it is not the machinery of organization nor even any unusual practice that makes a strong and efficient highway department. The supreme quality is organization morale. With such morale in Pennsylvania, remarkable work has been accomplished—an output per man unit far beyond that of most states. Morale has been created partly by personnel direction and in some measure by several other things, but fundamentally, it has come from enthusiastic leadership. The executives of the Pennsylvania highway department have "sold" its importance, its technical competency and its business rectitude so completely that every least departmental clerk is afire with belief in the department and its work.

Another fact that stands out is the perception that a state highway department is not merely the curator of an assigned system of state roads, but is the guardian of the roads of the state. In this broad capacity the duty devolves of educating the people to good road practice and of lending them technical aid and expert business and financial advice in their local road development.

Finally, the lesson that requires to be observed by those states of the West and South which are young in highway improvement is that maintenance is ultimately the governing task of state highway departments. Even with its enormous new construction programs in full swing last year, almost a quarter of the money which Pennsylvania spent went for keeping the roads in repair, which is perhaps a fair average between the state whose maintenance exceeds construction and the state whose work is yet all construction.

These lessons that have been indicated need to be taken to heart by the people who are voting millions for highway development. In every state they are constructing and assuming the maintenance and operation of a transportation system comparable with the railway system within the state and a comparable directing organization is required. Obvious as is this conclusion it is slow in being accepted, largely because of the lack of effort by engineers and contractors, through their national associations, to call even the briefest attention to its importance.

Vehicle Tunnel Under Way

AFTER about a year of delay due to friction between the two state commissions charged with the administration of the project, work on the Hudson River vehicular tunnel, comprising twin tubes of cast iron 29½ ft. in external diameter, has been started, under two contracts involving a total expenditure of nearly $20,000,000. The project is noteworthy not only because of the exceptional size of the adopted section—the largest subaqueous tubes to be built by the compressed-air shield method in the United States—but also because it marks the resumption of a type of construction on which there has been little activity in the New York district for several years past following the driving of the 14th St. subway tunnel under the East River.

The award of the vehicle tunnel contract comes opportunely at the beginning of the construction season—although tunneling is not so dependent upon climatic conditions as other forms of construction—and also at a time when labor is seeking employment not only in the construction of the tubes under the river but also in the plants which will supply the equipment and materials for the work. Ample funds are available for the project, an engineering staff headed by well qualified men has been developed, and a contractor experienced in subaqueous tunneling has been selected. The old animosities between the New York and the New Jersey tunnel commissions have been buried, following the recent removal of several Jersey commissioners, and the way is now clear for construction progress.

The design of the tubes follows well-established practice and, while new features have been introduced in a few details, the job will go ahead according to methods which previous experience has proved dependable. In the earlier stages of the project, it will be recalled, numerous suggestions for departure from previous practice—chief among which were the adoption of a larger tunnel section, the use of concrete blocks, and the trench method of construction—were suggested. Throughout this controversy the chief engineer to the two commissions held to the policy of following well established methods of design and construction rather than of embarking on experiments with the public funds.

In the contract and specification, as outlined elsewhere in this issue, one of the new features covers the matter of payment to the contractor. For work of this magnitude a very heavy outlay in construction plant will be required at the beginning of the job, to say nothing of the cost of the $4,000,000 surety bonds specified. The tunnel commissions have recognized this fact and have made provision for payment on plant, when installed, with subsequent monthly deductions from the contractor's estimate until the allowance for plant is thus wiped out. This plan, it is anticipated, will relieve the contractor to some extent of the heavy financial load ordinarily assumed at the beginning of a large job.

Exposure Fire Hazards and Protection

THAT fireproof buildings are excellent furnaces has been well known for many years. Great fires such as the Baltimore conflagration demonstrated this truth with startling clearness. In general perspective the Burlington Building fire in Chicago three weeks ago is a further demonstration of the same fact. But, in addition, it brings out new facts of first-rank importance.

The resistance of the building gives gratifying evidence that we have made progress in building construction. The fire did not communicate from floor to floor; protection of vertical openings, long fought for as a necessary objective by fire protection men, appears to have been substantially complete. Had an interior fire originated on any floor it would not have communicated to another, and would have left the exit and entrance facilities unimpaired. In this important respect, then, the building performed excellently. Moreover, no structural parts of the building failed, which also represents an advance, as may be realized by comparison with the general crippling of office building structures in the San Francisco and Baltimore conflagrations. But when we have looked at these pleasant facts, we face the unpleasant fact that the building wholly failed to protect its contents. It offered no resistance whatever to the attack of severe exposure fire.

If this is the best that can be expected of a "fireproof" office building, the business community has a choice of three evils: In the case of every large and important headquarters office the chance of total destruction at long intervals must be taken into account; or, such central offices must be split up among several different quarters not likely to be exposed to destruction at the same time; or, the outside exposure hazard must be eliminated by removing from the neighborhood all special hazards, that is to say all buildings that may become the seat of severe interior fire.

The choice is not so hard as it seems. The third alternative would be ideal if an equal and high degree of fire protection could be enforced on all structures but unfortunately this is rather beyond the bounds of present possibility. To mass all fireproof buildings in one group, and, separated therefrom, to mass all buildings of greater hazard in another group, would increase rather than diminish the general fire exposure of any community and would be counter to the principle recognized as desirable, namely that the fire risk of a community should be broken up as much as possible by fireproof buildings capable of serving as barriers between groups of buildings of lower fire resistance. There is something, however, in the idea of taxing property in proportion to its fire risk, but so revolutionary a practice does not offer any early relief.

So also may the second alternative be eliminated as improbable. The conduct of modern business appears to call for the concentration of large headquarters offices in one place, and for the present at least it is not to be expected that business will seek greater safety against infrequent fire risk by splitting up headquarters establishments. We face the conclusion, then, that occasional complete destruction of a central office establishment by fire must be considered probable. Exposure fires are the principal, perhaps the only, hazard in this regard, although a secondary teaching of the Burlington fire is that the contents of a modern office contribute in a surprising degree to the intensity of such a fire, and presumably may also give rise to a very destructive interior fire under favorable circumstances.

The risk of complete destruction will remain until better protection of window openings is applied than the Burlington building possessed. One question is whether we have or are likely to have better means of protection. But the important problem is to lead builders, owners and architects to appreciate the exposure risk sufficiently to use such means of protection.

We already have wire-glass as a protective device against exposure fire. According to the best authorities, wire-glass would have been of decisive value in the Burlington Building, had it been applied to the street front windows. Some believe that it would have protected the building completely, while others assert that it would probably not have prevented the entrance of the fire, but would have given the fire department a better chance. On either view, and especially with the fact before us that a few rows of wire-glass windows on the exposed street front of the Burlington Building showed more than twice the resistance of the plain glass windows, we must conclude that this one simple precaution would have had great value. It would have saved perhaps half of the loss experienced by the Burlington railway.

Since wire-glass has a limited resistance, as was demonstrated in the Burlington Building itself by the destruction of many wire-glass windows on the court faces, from heat developed in the interior, it is not the full and satisfactory protection that may be looked for. Perhaps some system of fire shutters may find a trial application as the result of this fire. This is a matter of the future, however.

Ten or twelve years ago wire-glass and metal windows were as readily available as now. Their use would have added a vanishingly small fraction to the cost of the Burlington Building. Their omission puts the whole building at risk. Undoubtedly, the officials of the Burlington did not appreciate this; they surely did not contemplate the possibility of destruction of a large part of the contents of their building when they erected it. They knowingly placed their office structure in a region where manufacturing and other buildings—both wooden and brick—surrounded them. Consciously or unconsciously, they as well as multitudes of others relied on distance—the width of a street—as adequate protection against exposure fire.

Fire protection engineers themselves rarely went so far as to suggest wire-glass or fire protection at street fronts; they themselves relied on street-width protection. Perhaps both classes of people were led to this in part by the feeling that under conditions so severe that the width of a street would not longer protect, nothing would protect. But that this feeling, if it existed, was not genuine after all is shown by the fact that they did demand and apply wire-glass and metal windows in rear walls, where distance was not available as a protection.

Reduced to the elements, the situation is that the sentimental and esthetic objections to applying wire-glass to street fronts were the real final obstacle to consistent application of window-opening protection. The Burlington Building is an unavoidable challenge to the attitude of mind that supported this objection. It sets up the query whether building construction must not take careful account of the exposure hazard, and, by protecting against it, seek to produce buildings that will come nearer to being safe for contents as well as for structure.

Placing 410,000 Cu. Yd. of Concrete on Ontario's Niagara Power Development—I

Plant Layout for Mixing and Placing Concrete for Power House, Forebay and Lining of Nine-Mile Queenston-Chippawa Canal—Design and Testing of Mixtures To Meet Prescribed Strengths

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AND

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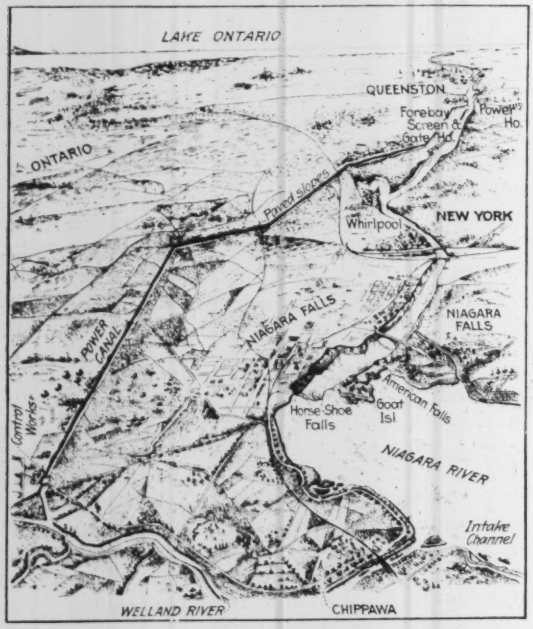
IN a period of 13 months 410,000 cu. yd. of concrete were placed from 21 different plants along 8½ miles of canal on the Queenston-Chippawa project, the power development around Niagara Falls that has just been put into initial service by the Hydro-Electric Power Commission of Ontario. The problems of maintaining adequate supplies of materals to these scattered plants and placng this quantity of concrete at a rate frequently exceeding 2500 cu. yd. per day required methods and equipment adapted particularly to the work in hand. The uniform excellence of the concrete which has resulted is an interesting example of the application of modern scientific methods to the control of the quality of a material ordinarily produced almost entirely by rule of thumb.



AIRPLANE SKETCH OF THE QUEENSTON-CHIPPAWA PROJECT

The general scheme of the development has been described fully in previous issues of *Engineering News-Record* and will be referred to but briefly in this article. It will divert around the Canadian side of Niagara Falls a flow of approximately 15,000 sec. ft. through a reversal of the Welland River for 4½ miles and a dug canal of 8½ miles to a power house at the Lake Ontario level at Queenston. In this construction the structures are all of concrete and the canal is lined with concrete. Practically all of this concrete was placed in the year prior to the opening of the canal on Dec. 24, 1921.

Concrete Structures or Project.—The intake, or head works structure, is at the junction of the Welland River with the Niagara, a short distance above the falls and upper cascades. For a distance of four miles upstream, the Welland River is dredged to give an added depth of 20 ft., with sufficient increase in width to provide the low velocities required for navigable streams.

From the upper end of the river improvement the canal extends for a distance of a mile in dredged earth excavation; the section of the waterway gradually changing from earth slopes to vertical walls as the rock formation is entered. Near this transition is situated a Stoney sluice-gate for the control of the flow of water in the rock section and for emptying the canal in case of necessity. The rectangular section in canal rock excavation continues through to the forebay, a distance of about 7½ miles, with the exception that the ravine, near the Niagara Whirlpool, is crossed by means of a heavy rock fill and this portion of the canal (three-fifths of a mile long) is constructed in trapezoidal form with transitions to the rectangular section at each end.

At curves, instead of maintaining the walls parallel to a common center line, the alignment of each side is on a radius of 300 feet and this arrangement provides an additional width varying with the amount of curvature throughout the length of the curves.

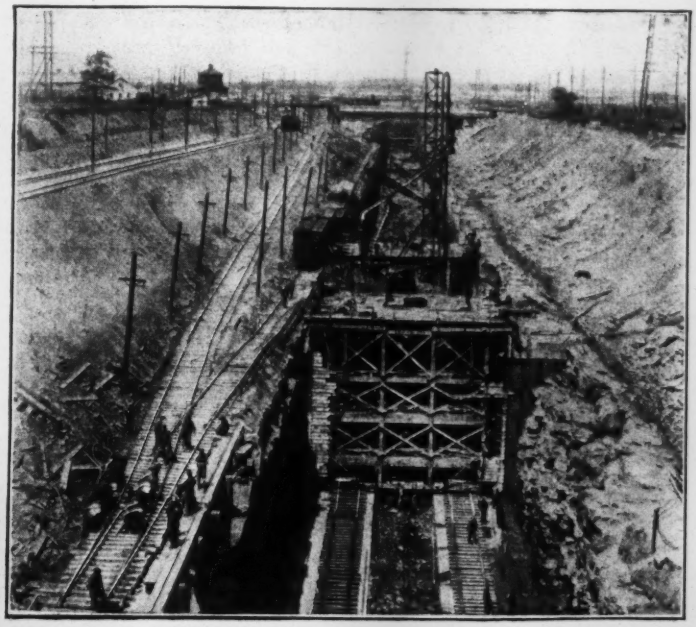
The rock section is lined throughout to a height of 34 ft. with plain concrete ranging in thickness from a minimum of 6 in. to an average maximum of about 24 in. The trapezoidal section is lined with reinforced concrete of 12 in. thickness.

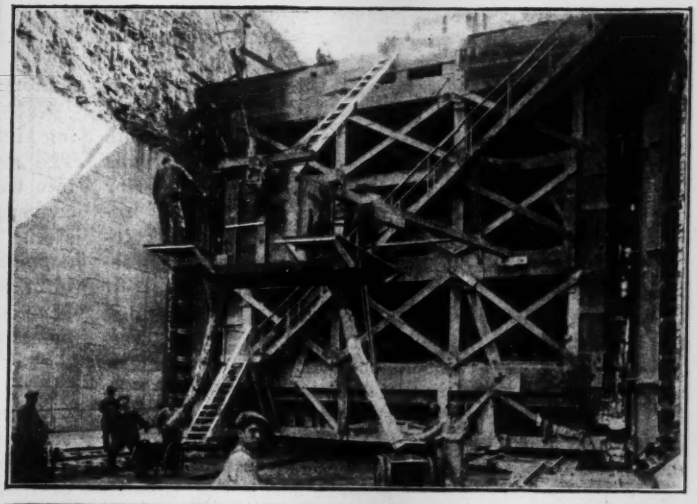
The forebay, 1,000 ft. in length, forms a basin at the downstream end of the canal and is terminated by the gate-house, which controls the supply to the penstocks and in which are situated the screens and a by-pass for ice. A wedge shaped deflector is located at the throat of the forebay for the purpose of dividing the flow into two equal streams in order to avoid the formation of eddies and whirlpools within the forebay with a consequent loss in head. This structure is composed of thin concrete walls and has a length of 220 ft.

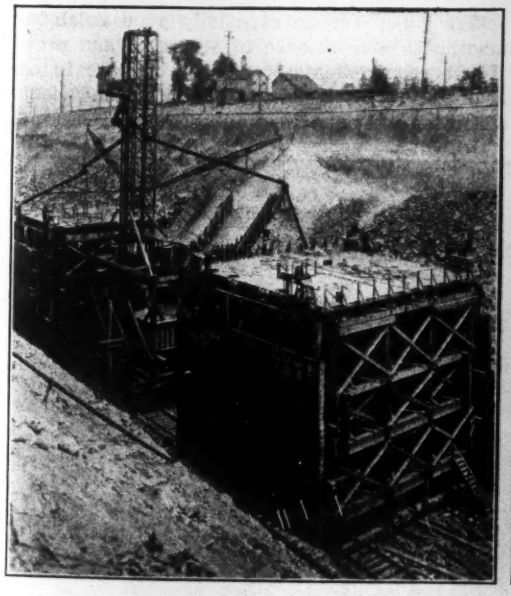
The upper ends of the steel penstocks are imbedded in concrete head blocks which form continuations of the gate-house structure. The penstocks are laid at an angle of 60 deg. with the horizontal in trenches cut in the rock forming the escarpment face and are encased throughout with concrete. The ice-chute is a reinforced-concrete pipe built in place and encased in a similar manner.

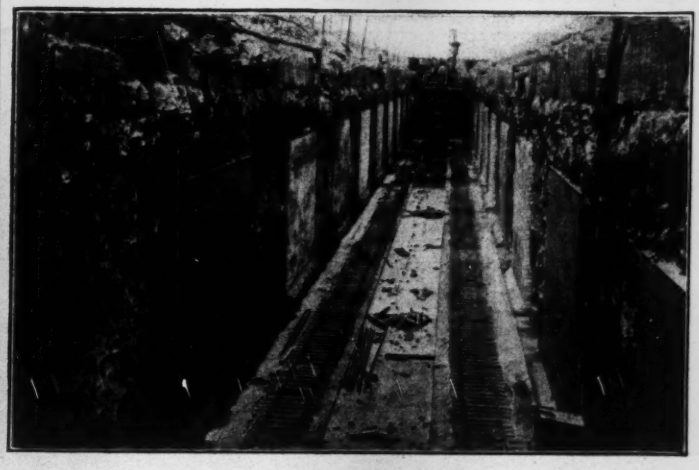
Generating Station.—The powerhouse is a massive concrete and steel structure founded on red Medina shale 25 ft. below the ordinary river level. As a precaution against possible floods due to ice jams in the gorge below, it is constructed as a water-tight monolith to a height of 55 ft. above ordinary river level. The outside walls are reinforced against this possible water pressure and all openings are provided with seals for use in case of emergency. Special care, therefore, was taken to secure a water-tight and dependably strong concrete in the substructure.

The whole weight of the generator and turbine is carried by a slab of concrete, with a span of 37 ft. It forms the casing for the upper, or vertical portion, and the roof of the lower, or horizontal portion of the draft tube. The slab is heavily reinforced, and in order to carry out the intent of the design it was necessary to place the concrete to a depth of 12 ft. in one continuous operation. From the bottom of the slab and integral with it, is suspended the lip or curtain wall forming the draft tube scroll, providing a gradually enlarging section. It was necessary to take the greatest care in connection with the design and erection of the centering and formwork and the placing of the concrete in order to obtain the results re-



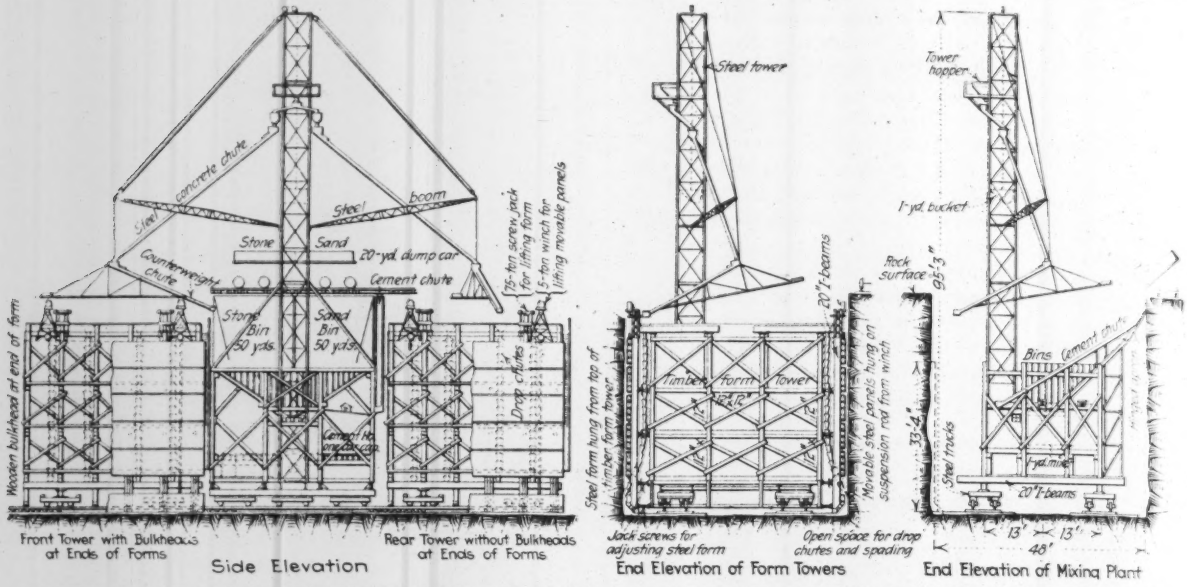






LINING THE RECTANGULAR SECTION OF THE QUEENSTON-CHIPPAWA HYDRAULIC CANAL

(Upper Left)—Scaling machine in background; paver at work in foreground placing outer rows of pavement.
(Lower Left)—One of the mixing and placing plants in operation, a concrete mixing plant from railroad on upper edge of bank delivers concrete to two sets of movable forms on either side.
(Upper Right)—Showing how tracks from aggregate storage are brought down to mixing plant.
(Middle Right)—A close-up of one of the lining plants.
(Lower Right)—Alternately lined sections behind one of the lining plants.



MIXING PLANT AND FORMS FOR PLACING LINING ON RECTANGULAR SECTION OF QUEENSTON-CHIPPAWA POWER CANAL

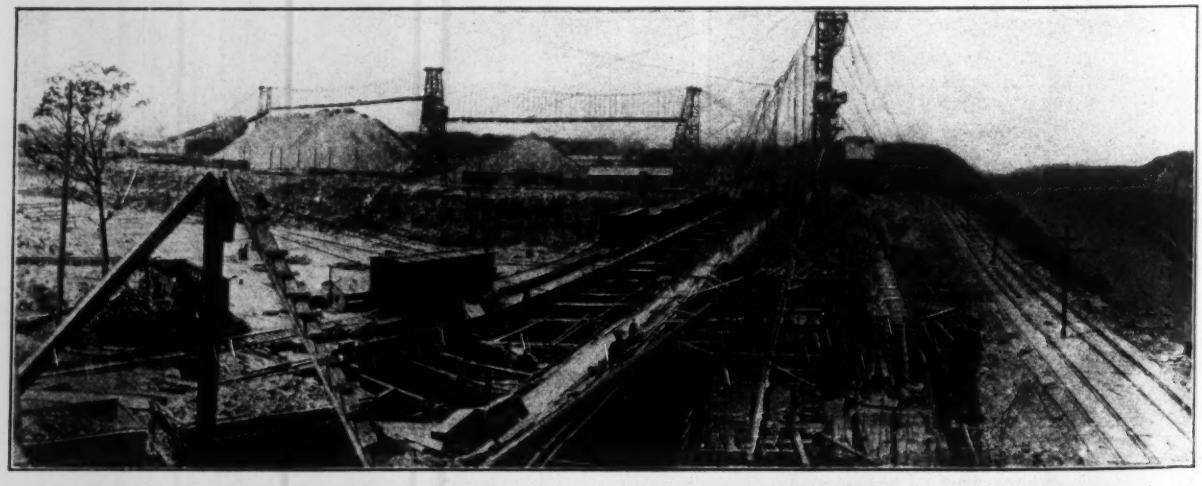
quired by the design. The substructure contains, in addition to the unit settings, the usual sumps, stairwells, pipe-tunnels, passages and chambers formed in the mass concrete.

The superstructure of the powerhouse is of concrete with steel columns and roof trusses. The interior walls are rubbed down with buffing machines but the exterior walls are to be left without other finish than that provided by the forms. The roof and floors are of reinforced concrete, the roof being waterproofed with asphalt and tile.

The structure for housing the transformers and high and low tension equipment is integral with the powerhouse and is similar in construction to the powerhouse superstructure, excepting that the concrete facing of the cliff forms the rear wall of the building. The cliff facing extends above the roof of the transformer house to an elevation 50 ft. below the top of the escarpment and forms the foundation for the escarpment wall, consisting of a series of arches carrying the high tension line towers and a portion of the boulevard of the Queen Victoria Park Commission, skirting the edge of the cliff.

Gate House and Forebay.—The gate house is a building similar in architectural features to the powerhouse. The substructure contains 27 openings, which merge into the 9 penstock entrances: the rectangular section converging to a circle at the upper end of the steel penstocks. It contains also openings for the penstocks supplying the service units. The substructure is of reinforced concrete throughout. The head blocks at the penstock entrances are heavily reinforced and their monolithic construction required an 800-yd. pour in one operation.

The design called for an especially good finish both as to smoothness and absence of waviness and projections. These requirements were met by care in construction of the forms and in the handling and placing of the concrete, and notwithstanding the presence of a



LOOKING ACROSS THE GATE HOUSE AND FOREBAY DURING CONSTRUCTION, SUMMER OF 1921
Downstream on Niagara River at right; gate house concreting plant and gate house forms in center; forebay and aggregate storage piles at left background.

large amount of intricate reinforcing, there was no necessity after the forms were removed to repair or rub down the surfaces exposed to the flow of water.

About half a million cubic yards of rock were removed to form the forebay basin. The rock throughout is seamy and in shallow layers and in many places it was found that seams and cracks extended to the face of the escarpment. To guard against seepage and consequent trouble due to water reaching the cliff face, the rock walls were treated by guniting 1 in. in thickness. This material, as applied, was extremely satisfactory, resisting every effort to destroy its bond with the rock.

Generating Station Plants.—All the concrete placed in the generating station and escarpment face has been poured from two mixing plants. Plant No. 1 was installed at the south end of the work on the cliff face just below the level of the penstock tunnels from the forebay. Material was delivered entirely in car lots from a trestle built across the forebay with its track at the upper ground level. The aggregates were dumped into large bins beneath the trestle and conveyed by belt to the hoppers at the mixing plant. The cement was unloaded from cars, passed down a chute to a belt and delivered thus to the plant storage. Both conveyors passed through the tunnel opening provided for the service penstock.

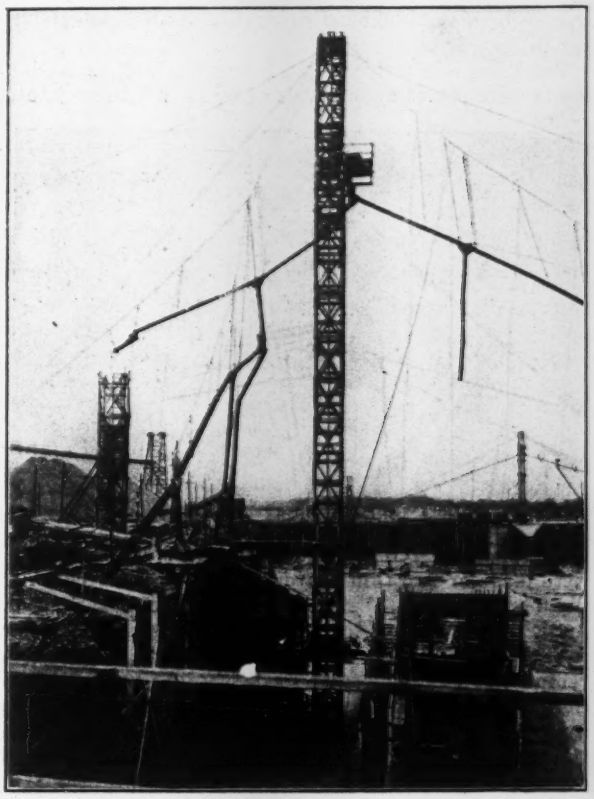
Progress of the work eventually required the dismantling of Plant No. 1 and its replacement by Plant No. 2 in a new location at the top of the escarpment near the north end of the work. The mixers of this latter plant were installed at a sufficient elevation to discharge into cars at the upper level. Cement and aggregates were delivered directly from the main storages to this plant, the conveying systems passing above the tracks and wires of the electrically operated International Ry. Each of these plants contained two 1-yd. mixers and concrete was delivered for the construction of the generating station by means of long steel chutes suspended from cables. The concrete required for the upper escarpment face and walls was poured from cars operating along the edge of the escarpment.

Gate House Plant.—The concrete for the gate house structure was placed from a plant located near the base of the forebay trestle; the materials being dumped from the trestle, stored in bins and conveyed to the mixing hoppers. Concrete was elevated in the central tower for distribution by chute. On account of the distance between this plant and the north end of the structure, it was found necessary to re-elevate a portion of the concrete.

Forebay Plant.—A mixing plant was erected at the junction of the canal with the forebay for the purpose of constructing retaining walls around the top of the forebay, the deflector and that portion of the floor of the forebay which was to be concreted. This plant was served from a track parallel to the side of the forebay; the whole arrangement being similar to the plant used for the construction of the gate house. To build the more distant walls, the mixed concrete was conveyed from this point in cars and discharged directly into the forms. The cars used for concreting the upper escarpment face and the forebay walls were of special design, consisting of four hoppers of 2 cu.yd. capacity each, mounted on old flat cars. These were fitted with side gates and were elevated on the cars to permit placing concrete to the tops of the walls under construction.

Two guniting machines were used for the forebay lining. These machines were of 4 cu.ft. capacity each and covered the rock walls to an average thickness of 1 in., at the rate of about 50,000 sq.ft. per month.

Canal Lining Plants.—The sequence of operations in lining the canal was: First, the paving of a strip 15 ft.



MIXING PLANT AT CANAL END OF FOREBAY

wide on each side of the floor; second, the construction of the side lining in alternate panels, 40 ft. in length; third, filling in of the intermediate panels of the lining, and fourth, the paving of the center strip of the floor.

For the transportation of concrete materials to the mixing plants, a track located on the rock surface at the edge of the excavated section extended on one side of the canal from end to end of the work. Part of this track was originally laid for the removal of rock excavation but a high level crossover involving a temporary railway bridge together with approximately three miles of additional track was provided expressly for concreting purposes. Pipe lines parallel to the work supplied both water and air under pressure.

The dividing up of the floor into three strips was arranged in order to get widths which could be screeded properly in a longitudinal direction. The central strip was left until after the lining was placed for two purposes—to provide space for materials cleaned up from the sides and also so that the dripping from the lining plant mixers would not fall on finished work.

The rock forming the floor foundation and the backing of the lining was seamy and water bearing. To give an idea of the amount of water entering the canal through the rock, it may be said that at times over fifteen million gallons per day were handled by the pumps; consequently before concreting could proceed preliminary operations of some magnitude were neces-

sary. To provide drainage for this water a concrete pipe-line was laid below grade along the center of the canal bottom. Sumps were opened and pumps installed at intervals of about half a mile. Wherever there was noticeable flow through the rock, the seams were opened up and bulkheaded with planks and the water was led from behind the bulkhead through a small pipe extending to floor level.

When the side strips of the floor were laid, expansion joints were placed at intervals of 30 ft. and these joints

CONCRETING THE VERTICAL LINING ON A CURVE

were made of two thin boards laid as an inverted "V": the top of this joint being 2 in. below the floor surface. A channel was thus provided for carrying all the water from the sides to the center drain. Where the seepage behind the side walls was so diffused as to render its collection impracticable, it had to be absorbed by the concrete and for this purpose the mix was adjusted from time to time by juggling the quantities of cement, sand and water in the batch.

The floor was for the greater part placed by means of traveling paving plants. Later the use of these was abandoned and the work was done by the several lining plants as they progressed, using chutes and buggies. The paving plants received materials through chutes extending up to cars spotted on the service track.

Wall Lining Forms.—The outstanding problems to be solved in connection with the lining of the walls of the canal were the extreme heights to be concreted in a single operation; the disposal of seepage; the necessity of obtaining the very best results in regard to density, smoothness of finish and adhesion to the rock; and the great distance over which the operations extended.

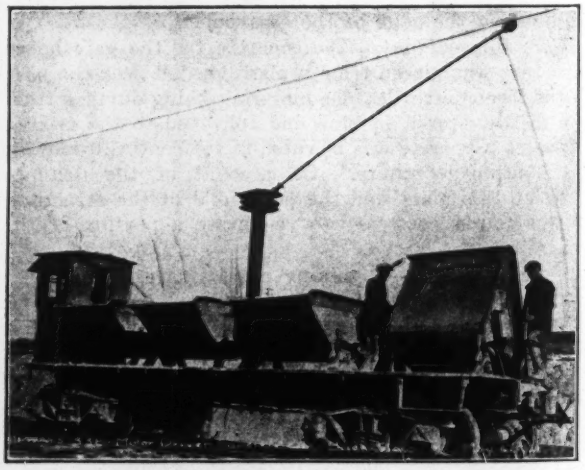
By the end of 1920 two miles of the canal prism had been excavated to grade and made ready for concreting and the program for concreting the remaining distance of 5½ miles had to be adjusted to suit the operations of the five high lift shovels, which were working in separate openings and scheduled to finish simultaneously. Hence it was necessary to install somewhat more lining equipment than would have been reqquired, for the sole purpose of completing the concrete work immediately after the shovels had finished the excavation. This program worked out so that excavation was completed on Nov. 30; concreting was finished on Dec. 18, and water admitted to the canal on Dec. 24, 1921.

For the purpose of constructing the side walls in the canal prism nine lining plants were erected and used while a half plant was re-assembled from the two plants first dismantled. The lining plants were designed having in view the requirements of strength and speed under which they were intended to operate. Details are shown in the accompanying drawing and views. Each plant was complete in itself and consisted of three units; form units in front and rear, with a mixing unit between the two. Each unit was mounted on special trucks and travelled on tracks laid on the two side strips of the floor already placed. Moving was accomplished by means of tackle attached ahead to heavy pins set in the rock bottom; motive power being supplied by the mixer hoist. Each form was suspended from two 75-ton jacks resting on a central structure of steel beams and heavy timbers designed to take care of the dead weight of the form panels; the heavy stresses due to moving, and the thrust from a full head of liquid concrete. This last assumption was fully justified by the conditions which developed after the forms were in use. Each form was kept in place by means of 24 screw jacks operated by hand wheels. The form was made of ⅜-in. plate backed with steel beams and consisted of a base panel four feet high and five movable panels each about six feet high. The base panel was shaped to form the bevel at the bottom of the side walls. The movable panels could be raised so that spading operations for each 6 ft. lift might be carried on by working between the panels The panels were raised and lowered by means of rods suspended from winches at the top of the structure.

The top of the structure supporting the forms was floored over and through this flooring five openings were provided on each side for concrete hoppers, which discharged into flexible drop chutes reaching to the bottom of the forms. A stairway extended from top to bottom giving access to platforms at intermediate levels from which the concrete was spaded.

With this type of plant it required from but 6 to 8 hours to fill one set of forms while the maximum output per week reached was 320 lin. ft.

The mixing plant carried a divided bin for aggregate storage with a total capacity of 80 cu.yd., arranged

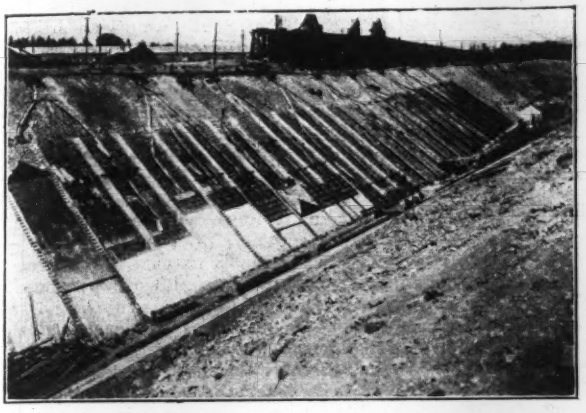


SELF-DRIVEN CONCRETE CAR USED IN SLOPE PAVING

to receive aggregates side-dumped from standard 20-yd. cars discharging from the service track which in some places was over 40-ft. higher than the bins. It also contained storage room for a carload of cement. The mixer, of 1 cu.yd. capacity, was operated by electric motor and concrete was elevated in a 1-yd. skip by means of an electric hoist and a steel tower 95 ft. high.

At the top of the tower was situated a hopper discharging into two lines of chutes for concreting front or rear forms as desired. The mixing plant also contained apparatus for the application of calcium chloride. The total weight of the three units composing a single lining plant was over 500 tons.

Lining the Curves.—The extra width of the canal section at the curves made possible the ready moving of the lining equipment through them. Special wooden forms were used for the concreting of the curves, the surface of the lining being a true arc. The panel sec-



SLOPE PAVING IN THE WHIRLPOOL SECTION
Concreting plant in background on bank; alternate methods of laying concrete shown in view.

tions were held in place by vertical timbers bolted to the solid rock; sleeve nuts just inside the concrete face being used to permit the removal of the outer portion of the bolts. At first a portable plant was used for the mixing and placing of concrete at the curves but during the final period, concrete was transported from the stationary plant at the Whirlpool section. Concreting of each curve occupied a period of about three weeks; the forms being erected for one-half the length and used twice. The same forms were then removed for use at another curve, of which there were five in all.

Slope Paving.—Due to the depressed elevation of the rock surface at the Whirlpool section and its total disappearance from the canal prism in the Whirlpool ravine, it was necessary to construct this section in the trapezoidal form referred to previously, with two transitions from the sloping, to the vertical sides, and over a mile of retaining-wall on each side of the prism. For this work a stationary plant was erected capable of turning out 1,000 cu.yd. of concrete per day. This plant consisted essentially of a timber trestle on a 3 per cent grade for delivery of aggregates arranged so that materials could be discharged either from bottom or side dump cars into storage bins. The materials were delivered by gravity to the mixers—cement was unloaded from a track alongside the plant. The mixers were set sufficiently high above the ground so that the mixed concrete could be discharged into cars.

It was regarded as impracticable to maintain delivery of raw materials throughout the season to the opposite side of the canal and for this reason the plant was designed to do all mixing for the section at the one site and convey such of the concrete as was required to the opposite side by means of a chute 330 ft. long. Material was elevated for this purpose by means of a tower 180 ft. high. A low tower was erected on the opposite side, and between the two towers the chute was suspended on a slope of 22 deg. from the horizontal. Two mixers supplied concrete for the work on the side on which the stationary plant was erected and a separate mixer was provided for the concrete to be delivered for use on the opposite side. Approximately 15,000 cu.yd. of mixed concrete was chuted across the canal from this mixer. The consistency of the concrete was such that delays or stoppages due to clogging of the chute were practically non-existent.

Specially designed all steel motor-driven cars, made on the job were used for the handling of material from this plant. Steel beams were mounted on standard gage car trucks and on these were placed four 1½-yd. side dump concrete car bodies, so spaced that two mixers could be discharged into them simultaneously.

The work done by the Whirlpool plant was in itself a job of large proportions and while the construction of retaining-walls and transitions offered no unusual features other than their magnitude, methods devised for placing the concrete forming the slopes of the trapezoidal sections, was of a most interesting nature.

With the use of wooden forms narrow concrete strips were constructed up each slope to the finished canal section, these strips acting later as guides for the movable forms used for filling the wide spaces between. The movable forms were essentially wide screeds and consisted of a steel plate on a structural steel frame. These forms were weighted down with sand bags and drawn up the incline by means of an eight-part-line tackle attached at the top of the slope to a small hand-operated winch. Continuous operation of this winch resulted in a rate of progress up the slope of about 8 ft. an hour. Concrete reached the forms in galvanized iron chutes laid on the slope and as the forms progressed the surface was given a trowel finish. Six of these forms were in commission and a daily rate of 4,000 sq.ft. was reached.

The Whirlpool plant supplied concrete for other works along the canal. Concrete was delivered in good condition from cars, at a distance of over 3 miles, the mix being specially proportioned for the long hauls.

Separate Plants for Bridges.—During the period of canal construction several heavy reinforced-concrete arch skew bridges were built to take care of four important railway crossings. The bridges were similar in design and construction and the largest only is described here.

This bridge carries the double-track main line of the Grand Trunk Ry. and a single track of the Michigan Central R. R. on a parallel right-of-way. It has a span of 72 ft. and a width of 187.4 ft. During construction the tracks were diverted to a 3-track trestle in a middle position, permitting the two outer portions of the arch to be built first. The lines were then replaced in their original locations on temporary trestles resting on the arch, after which the central portion of the structure was built. Finally the arch was earth-filled from a borrow pit nearby.

For the construction of this bridge concrete aggregates were dumped into bins built at the bottom of the canal and cement unloaded directly from cars. The mixer was fed by gravity and the mixed concrete elevated by skip and tower and distributed to all points by chutes. The skews were poured over the whole of the arch in rings varying from 6 to 18 ft. in width.

(To be concluded)

Railway Ties from the Tropics

By Nelson Courtlandt Brown
Professor of Forestry, Syracuse University, Syracuse, N. Y.

Abstract of paper before American Wood Preservers' Association.

UNLESS more extensive treatment of ties is practiced in this country and a comprehensive system of foresting is decided upon we will soon be looking to the tropics, the only available source of supply for our 450,000 miles of trackage. At the present time our knowledge of these tropical resources is exceedingly meagre.

During the past 30 years or more, attempts have been made to introduce tropical ties to this country, especially from the West Indies and South America. Steamship lines have offered tonnage at a negligible cost or in some cases at no cost in order to get such a movement under way. It is obvious, of course, that tropical woods of high durability, hardness and weight, such as mahogany, greenheart, lignum vitae and quebracho would prove to be very excellent ties if their prohibitive cost for cross-tie material did not prevent their further introduction.

Ties have been brought here from Cuba, Colombia, Brazil, Argentine, Africa and Venezuela. Generally speaking, the atmosphere and soil conditions are much more severe as affecting the life and utility of ties in those countries than here.

About 25,000 ties were imported from the Amazon district of Brazil and placed in the trackage of five eastern railways in the years 1915-16-17. One railway placed 5,000 ties, including 15 to 20 different varieties of hard, heavy woods from Brazil. They were presumably well-seasoned when put into service and it is reported that all failed within four years except one species locally known as masaranadauba. During the past year all other varieties have been removed from the track. The failure was reported due to "brooming" and to some extent to decay. All of these ties were 7 in. x 9 in. x 8½ ft. Various opinions have been given as to the cause of "brooming" which is not supposed to exist in the native habitat of the wood. Some state that the difficulties were due to changes in climatic conditions; that is, change from extreme heat to extreme cold combined with heavy traffic and loads, crushing the ties after they have been checked severely. Some engineers have stated that if properly seasoned the ties would work out much more favorably. Another species, javaira, is reported to have done fairly well.

It may be of further interest to recite the experience of railways in several tropical regions and of other sporadic attempts to use tropical ties in this country.

The director of Forestry at Manila reports that the following woods last from 8 to 12 years untreated in the Philippines; that they require no tie plates and that the ordinary rail spike does not work loose in them. Locally these woods are called molave, ipil, yacal, apitong and guigo. The Philippine Ry. Co. now accepts 35 different native woods for ties.

The Sante Fe has tried out 200,000 stringy bark and blue gum (eucalyptus) ties from Tasmania. These were nominally only 5 in. x 8 in. x 8 ft. long but many of them were less than 5 in. in thickness. These ties did not stand up under the heavy service to which they were subjected on account of the thinness. The same railroad tried mangle prieto and chico sapote from Mexico but on account of the inexperience of the tie makers they did not prove satisfactory. Officials of this railroad state that it is really unfair to give wide publicity to this failure.

In British Guiana tests were made on 13 varieties of treated native woods and Baltic pine by a local railway. The native woods were all of hardwood measuring 4½ in. x 9 in. x 9 ft. long, the ties were grooved ½ in. in depth to receive the rails and bored with ¾ in. holes for nail spikes. After eight years all varieties except three were sound and in good condition. These three were kautaballi, untreated mora and treated Baltic pine which was badly decayed throughout. The latter wood is the one chiefly used by European railways and lasts 25 years in England when treated. The tests showed that (1) the native woods after treatment were far superior to the treated Baltic pine and that (2) mora and wallaba (*eperua falcata*) when treated resist decay under extremely adverse conditions of climate, precipitation and poor ballast.

Both mora and wallaba are abundantly available and can be produced fairly cheaply. There are three varieties of mora of which the red mora (*dimorphandra mora*) is by far the best. When properly seasoned the red mora makes an excellent tie timber.

This experiment would also seem to bear out the contention that tropical ties should be used only in the treated condition. If this is so, it is unlikely that we shall look to the tropics to supply any considerable portion of our cross-tie supply for a long time to come.

One large American railway carried on a test covering 30 varieties of tropical ties, chiefly of South American origin. Most of these failed in 7 years due to splitting and decay. Some only lasted 2 to 5 years, while a few such as mora, cacaque, roble pellin and quebracho remained for 10 to 12 years except the mora which varied from 4 to 12 years.

Another railway in the East used several thousand Brazilian ties in recent years. Of 2,647 ties examined closely 827 were removed from the track on account of splitting, "brooming" and decay after a service of 2½ to 3½ years. The engineer of tests states that many more will have to be removed after slightly longer service.

In Cuba, two of the railways report extensive experience with 25 different kinds of hardwood ties, all of which must be bored for spikes on account of their extreme hardness. Of these woods they report the following to be most satisfactory—in the order named—jiqui china, arabo, jucara negro, sabicu, caoba, quibra hacha and acaua. The length of service varied from 5 to 25 years, the average being about 11 years. All are used untreated. All ties are 6 in. thick, 8½ ft. long with round edges. No tie plates are required and all ties are adzed. An extremely rigid inspection is necessary as many woods resemble each other and an expert in tropical woods sometimes will err in classifying them. At present practically all the available hardwood ties in Cuba come from the province of Camaquey.

The railways of Brazil, at first particularly dependent on imported ties, are now using almost entirely native woods. One company with about 2,000 miles of railway uses 350,000 ties annually and accepts 47 different kinds of wood growing along the right of way. These last from 10 to 12 years untreated. They are all hewn from comparatively small trees, and in 1918 cost the railway 60c. apiece delivered.

The railways of Southern Brazil (Parana, Santa Catharina and Rio Grande do Sul) use annually about 450,000 ties which are now cut from embuia, a common hardwood. These are said to last 15 to 20 years untreated and are much sought after by the railways of the State of Sao Paulo.

Many tropical countries, such as Brazil, Guatemala, Colombia, Venezuela and the Guianas are now using native ties whereas formerly they imported ties from Sweden, Canada, the United States and Australia. Lack of a knowledge of the local timber and its suitability for cross ties, labor difficulties or insufficiency were responsible for importing ties from temperate to tropical climates.

London Subway Extensions Sanctioned

(*London Correspondence*)

The London Underground concerns have completed their negotiations with the British Government on the question of extending the city's subway system. As a result of these negotiations the extensions sanctioned will involve a capital outlay of £5,000,000, the work will take two years to complete, and employment will be found for about 20,000 men for this period. The proposals include the enlarging of the City and South London tube and linking it up with the London Electric Railway; the extension of the Hampstead and Highgate Railway (north London); and the linking up of the Central London and London and Southwestern railways at Shepherd's Bush (west London).

Putting Business Methods Into State Highway Management

Pennsylvania Develops Theory of Organization—Management Division Co-ordinates Work—Educational Supervision Emphasized—Work Authorizations Control Expenditures of $45,000,000 in One Year

FOR two years Pennsylvania has led all states in the combined mileage of paved roads built and of roads of all kinds intensively maintained. In 1921 the state spent $35,000,000 for new construction and in excess of $10,000,000 for maintenance. It is common knowledge that this extensive program of improvement proceeded with less friction and more speed than prevailed in many states whose expenditure was not one-tenth as large. A highly developed state highway department organization is the reason for this success. The salient characteristics of this organization, therefore, invite careful attention by states in which extensive construction and maintenance are, comparatively, just beginning. They are as follows:

A definite theory of state highway department organization has been worked out. All branches of department work are co-ordinated through a management division which has called to its aid the most complete system of graphic records perhaps ever employed in engineering construction. Educational supervision by the department has been carried down to township construction and maintenance through an advisory bureau. Exact financial control is managed by means of a budget plan and a system of work and cost authorizations.

Premising that highway development is a continuing business the organization of the department is that of an industrial enterprise. It functions directly; it has flexibility for curtailment or extension of operations; it seeks permanence of personnel and bases promotion on performance; it requires precise accounting and cost keeping; it keeps all records in shape for instantaneous use. In brief, *business efficiency* is set down as the first organization requirement.

Public service is the second requirement. Being an organization for public service, it is held that quality of product is primary; that expert technical direction is therefore essential; that fair dealing with contractors and in all business relations is called for; that information and records are at the command of any legitimate inquiry, and that complaints must receive immediate and courteous attention and errors must be promptly corrected.

An *organization adequate to the work* is consistently maintained. This is considered so important a requirement as to be subordinate only to business efficiency and public service as a fundamental organization principle. Size of organization, as Pennsylvania highway officials interpret it, does not signify merely a large force; it signifies large capacity for production. This involves logical division of labor under central direction; a planning bureau to co-ordinate effort; a skilled personnel trained in teamwork; and high organization morale. Pennsylvania experience stresses size of organization.

A state highway department transacts annually a business amounting to millions. Pennsylvania in 1921 spent in round figures $35,000,000 for road construction and $10,000,000 for road maintenance. Many states are spending from $10,000,000 to $20,000,000 and there are few states in which the annual expenditure for highway improvement is not at least $5,000,000. These are large business operations and they require directing organizations of commensurate size. If they are not provided the mileage cannot be produced or if it is produced either the cost is high or the quality is inferior.

A Few Features of Pennsylvania's System

Complete Graphic Records
Close Financial Control
Promotion on Performance
Square Deal for Contractors
Developing Teamwork
Intimate Data on Personnel
Uniformity in Office Practice

The machinery of organization, though carefully planned by the Pennsylvania highway officials, is regarded as less vital than organization morale and teamwork. Emphasis is placed on these qualities because, without them, it has been found by experience that an organization for public road work, however perfect its machinery, gives partial and less efficient service. The performance records for three years show that practically every function of the organization—routine testing, materials surveys, engineering supervision, general administration—costs less per unit, with three years of heavy construction and intensive maintenance behind than it did at first with men not trained to work as a team.

Capacity, business efficiency and public service, are, then, the fundamental requirements of highway department organization as they have been determined in Pennsylvania. With them as principles, the functional organization has developed as shown by the chart, Fig. 1, standing out in which is the central circle of management.

The management division is a co-ordinating authority to interpret executive policies and reduce them to standard procedure. In general, its functions are:

To determine the various operations of the department in accordance with the requirements of the highway laws; to group these operations on a divisional basis and assign them; to create the necessary divisional organization, and instruct each division in the standard methods of operation; to interpret executive policies in accordance with the scheme of organization and present them to the divisions in their proper relation to each; to schedule the performance of all department work and follow up the schedules. The chart, Fig. 1, shows the bureau and section organization created for the work.

Authorization and recording, it will be observed, are the outstanding functions, with personnel work next in importance. Authorization can be explained more clearly in considering maintenance direction and will be disregarded for the moment.

Personal relations and personnel are made a special duty by the management division. Permanence of employment and promotion for merit are considered

matters of course. Personnel direction goes much further. A detailed—almost intimate—personal record of each employee is kept. Its first purpose is to rank the employee in respect to promotion and pay, but an equally important purpose is to ascertain his availability for transfer from one branch of service to another. This is very important in preserving permanency of personnel, for different divisions or bureaus have their peak loads at different seasons, and an employee, if his proficiency is known, can be shifted from a department where work is slack to another where it is crowding the regular force, when otherwise he would often be laid off. So intimate are the personal records kept that they cover an employee's absences from work and their reason and his tact, diplomacy and personal likability.

Instruction is an essential part of personnel direction. It is directed particularly to the outside office employees to co-ordinate their work and thinking with department practice and policies. Regular visits to district offices, combined with questionnaires and books of instructions, are the means employed.

Personal records, as described, are an index of the comprehensive recording system by which the management division keeps in touch with the department work. Four of the eight sections of the division, as the chart Fig. 1 shows, are concerned with records. The notable feature is that all records possible are graphs. Examples of any but the most simple charts, as Figs. 2, 3 and 4, are impracticable to show, because of the combinations of colors and symbols employed to indicate almost every detail which the statistical tables contain, but their number and purpose comprehend practically all department information. A glance will tell for example how many days any employee has been absent for sickness or any cause; or what condition of maintenance exists on any highway; or the mileage of each kind of highway in every county, or any other thing that the statistical tables embrace and the department or the public is likely to want to know. These scores of charts are mounted on swinging panels and can be consulted at any time by any one having a legitimate reason.

This chart system of records is considered highly important and is kept closely up to date. It is stated that the time consumed in charting current records is only a few man-hours a week. The use of the records, on the other hand, is constant within the department and also by the department heads to instruct delegations with petitions or bringing complaints. The system is usable by any of the department officials, without searching out the record keeper to disclose and interpret the information. Indeed the visitor conversant with highway work can by a few minutes study interpret almost any chart, as may be seen from the samples, Figs. 2 to 4.

Instruction of branch office employees in connection with personnel direction has been mentioned as an example of educational supervision. A more important line of effort is through the Township Division, Fig. 1, which acts in a supervisory capacity to the township highway officials. This work is considered constructive in two ways: (1) It ensures that local roads, which ultimately may come under state department direction, are in the meantime being developed along the standards and practices of the department; (2) it keeps the public thinking intelligently of road improvement and helps in getting authority voted when extensions of the state-system improvement program are under contemplation.

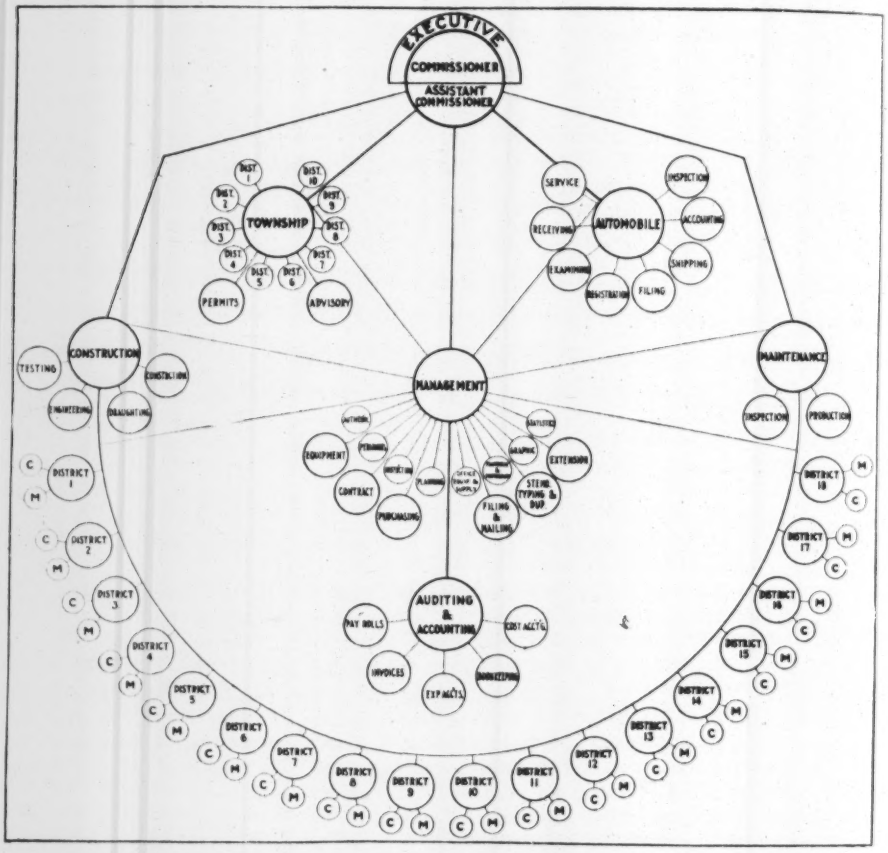


FIG. 1. FUNCTIONAL ORGANIZATION CHART

Briefly, through the township division, local road construction and maintenance has at command engineering experience and skill far beyond the possibilities open to small communities dependent solely on their own initiative and resources.

Exact financial control is set down as a cardinal department policy. It is effected by a budget based on estimates and by means of work authorizations which cannot be exceeded. To illustrate procedure the finance chart of any maintenance operation is illustrated, Fig.

5. With appropriations made, there follow careful estimates from which a budget is planned, then definite authorizations for work to be done, followed by accounting and cost reporting, as the work proceeds.

It is laid down as a principle that the intelligent distribution of funds must of necessity result in a *budget*, this budget being prepared from annual estimates furnished the main office by the representatives in the field. For convenience, maintenance estimates are divided into six general classes: (1) Indirect expense is a charge covering salaries and expenses of the field offices and forces. (2) General repairs, as the term implies, takes into account the different classifications for the proper maintenance of the total mileage of highways—the crowning and dragging of earth roads; placing of drainage other than bridges, and the necessary repairs to improved roads. (3) Resurfacing, which includes the reconstruction of the different types of pavements already laid, either with the same material or with a higher type of construction. (4) Surface treatment, which includes the purchase and application of the bituminous material and the chips or other covering material. (5) Bridge construction, and (6) repairs to tools and equipment.

The preliminary estimates are prepared by the field representatives after a careful and thorough study of each route. The roads are gone over foot by foot, distributing each estimate among the several units of work coming under the various classifications. No guess or approximation is allowed. The engineers are held strictly to actual figures, so that each has a personal pride in seeing that the work is done within his estimate.

These estimates are totaled in the Maintenance Division under the different classifications and are gone over very carefully. In the event that the estimated amount required is in excess of the estimated revenues, it is necessary to make reductions. In the estimate for general repairs, the reduction is accomplished by comparing such estimate with the amount of money expended during the preceding three years upon the different roads, always endeavoring to develop work of a permanent character, such as widening, construction of guard rail, and the placing of surface and subsurface drainage at particular locations. The reduction in estimates for resurfacing is made after a personal inspection of each project by a maintenance inspector from the maintenance division, who takes into account the importance of the road, the traffic, and the possibility of substituting cheaper repairs. Reduction in surface treatment estimates is made by a personal inspection of the roads and a reference to the chart showing the character of the treatment they received in past years, together with an appraisement of the probable traffic that the road will carry during the coming season. Reduction in the bridge construction estimates is taken from the bridge records kept in the main office. These records are compiled from an actual inspection of each bridge, made by an engineer of the bridge division, which gives in detail the physical condition of each structure.

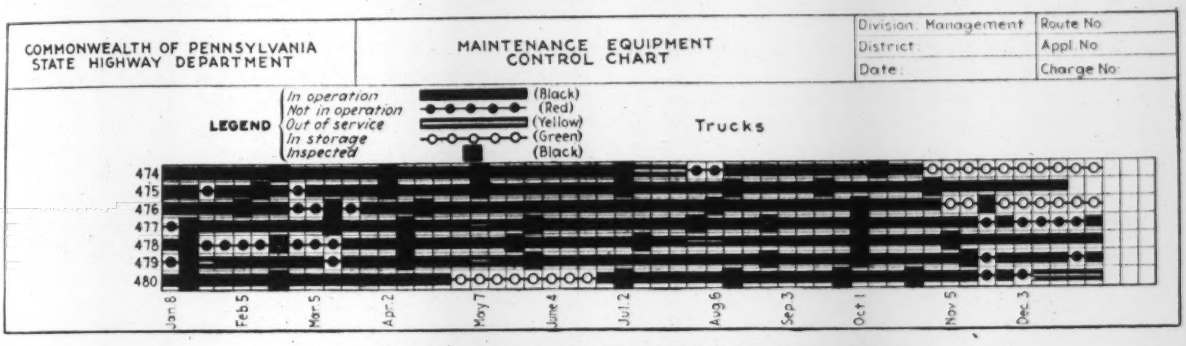


FIG. 2. SERVICE OF EVERY PIECE OF EQUIPMENT RECORDED

These estimates are then returned to the engineers with notations as to the advisability of the reduction or elimination of certain work and after the corrections have been made are again forwarded to the main office for approval and the issuance of the necessary authorizations.

Upon receipt of the final estimates, *authorizations* for the different classes of work are issued from the Maintenance Division. A code number system is used to readily designate the type of work and approximate location. These authorizations are issued in quintuple, one copy going to each of the several interested bureaus. This includes a copy to the auditing division, from which an account is opened up chargeable to this authorization; one to the management division as the co-ordinating division of the department; one to the purchasing bureau, in order that purchases can be checked against the authorizations; one to the maintenance division, for the purpose of record and control, and one to the district engineer, which is his notification of the specific amount he has been allotted for a particular object.

This authorization is the instrument used to control the funds and in no case can it be exceeded. It denotes the funds which are to be distributed over the entire

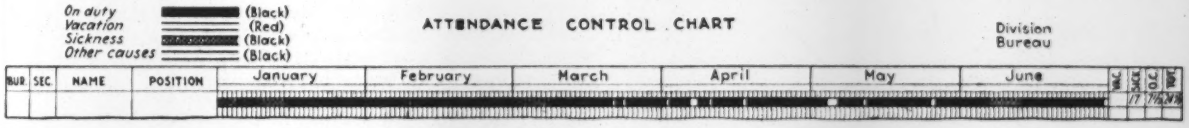


FIG. 3. EMPLOYES' DAILY ATTENDANCE CHART

season and, in the case of general repairs, the entire length of the route in the specified county.

Field control of funds is vested in an engineer's authorization by which he apportions to the superintendent the funds for a certain definite amount of work which is listed on the face of the authorization, excepting in the cases of surface treatment and resurfacing, when the entire amount of the department authorization, is issued. The engineer's authorization is issued in triplicate and forwarded to the maintenance division for approval. One copy is kept in that division for record and the other two returned to the district engineer, who retains one for his file and forwards the remaining copy to the superintendent as his notification that the work is authorized.

A special single-entry ledger is used both in the field and main office to keep a record of expenditures. The purchase order, which is the authority for a vendor to furnish certain material to the department, is considered as a liability. The main office receives a report each month upon each authorization issued, according to

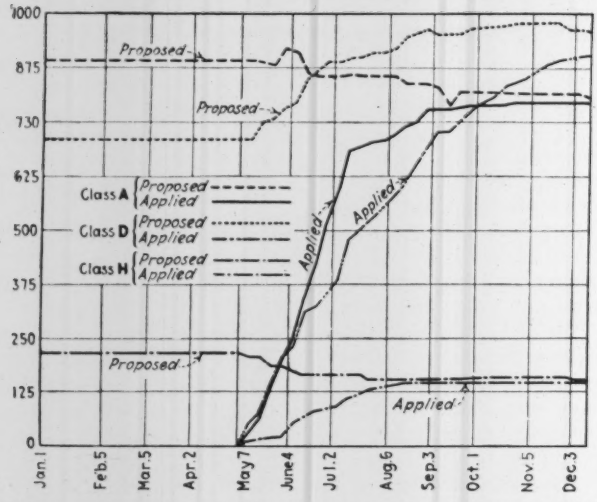


FIG. 4. MILEAGE OF SURFACE TREATMENT RECORDED

classifications. This, being summarized, gives the total amount expended each month under each classification on every route in the entire state.

In order that there may be uniformity in all office procedure, a regular system of field office inspection and audit is employed. Any field representative can be transferred from one office to another and the same system of bookkeeping and filing will be in effect.

Occasionally, the funds authorized for a certain project will be in excess of those actually required and by means of a cancellation and transfer report the engineer, with the approval of the maintenance engineer, may transfer funds from one project to any other authorization in his district coming under the same fund. Upon the completion of an authorization and at the end of the year a report is compiled by the superintendent, which itemizes all payrolls and purchases. This is in turn checked by the district engineer's office and is forwarded to the auditing division in the main office for check and record. Any unused amount, not specifically transferred to other work, automatically reverts to the general fund.

While the details of financial control, that have just been given, apply specifically to maintenance, the general practice indicated is the same for all department expenditures. Every piece of new construction, for example, is controlled by a work and cost authorization.

Pennsylvania experience has developed a theory of

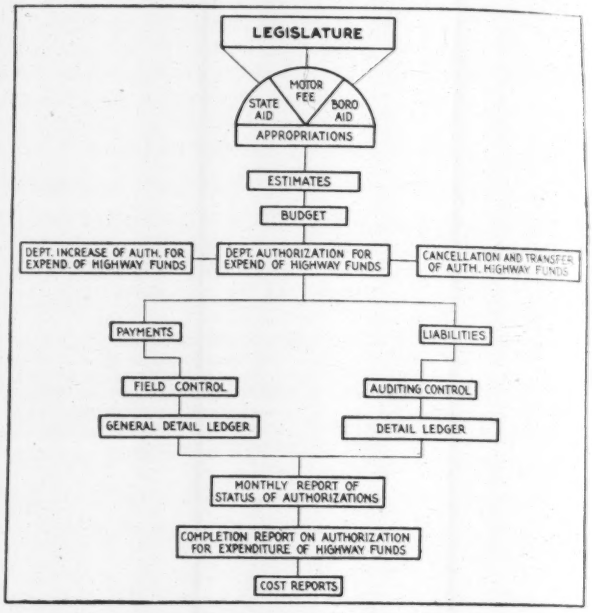


FIG. 5. MAINTENANCE FINANCE CONTROL CHART

highway department organization which, with central planning and co-ordination, educational supervision and financial control by budget and by job authorization, is universally true and applicable.

A Newspaper Appreciation of the Engineer

Commenting on the organization of a Minnesota federation of architectural and engineering societies, the Minneapolis *Journal* published recently under the head "What the Engineer Does for Us" the following appreciation of the services rendered by the engineer:

Few laymen realize or comprehend what a part these men play in the development of this state and city. It is the engineer who plans our highways and railroads and automobiles. He provides our electric light and power, our oil and gasoline, our supplies of pure water. He plans our buildings, bridges, elevators and mills. He has developed our great iron mines, the water power that runs our industries. He has now come to the rescue of the farmer, and is showing him how to irrigate or drain and prepare his land, how to plow, seed, cultivate, harvest, store and market his crops at a less cost and with less labor. To the engineer practically nothing is impossible, if money with which to do it is available, but he is the last man to advise expenditure, unless practical and commensurate results can be obtained. He must know how to accomplish the required results, how to calculate the cost in advance, how to select the method that will cost the least, considering all things. He must assume heavy responsibilities for the safety of life and property. He must be engineer, salesman, diplomat and statesman, and with all have a knowledge of law and economics. He must build his castles in his mind, before he can put them on paper; he must study, cut, fit, and try, before his plans are ready for the constructor who will execute them. But it is these same paper plans that control and make the success or failure, the economy or extravagance, the safety and security of the enterprise. If the engineer errs in his knowledge and judgment, the results may be not only unsatisfactory but disastrous.

Elimination of Odor in Sewage Gases by Burning

After Numerous Costly Experiments at Austin, Tex., Imhoff Tank Gases Burned to Destroy Own and Raw Sewage Odors

BY C. E. LEONARD
City Engineer, Austin, Tex.

ODORS from the raw sewage and treatment plant at Austin, Tex., are eliminated by passing them through a furnace in which the fuel is the gas from the digestion tanks. Numerous experiments using gasoline and distillate as fuel did the work but at too much expense. By the present method the plant generates its own purifying fuel. The disposal system (*Engineering News-Record*, Dec. 25, 1919, p. 1066) consists of a diversion chamber, pumping station, four cylindrical Imhoff tanks and sludge drying beds. It has a nominal capacity of 2.5 m.g.d. but can handle a maximum of 4.6 m.g.d. The population served is about 40,000. The plant was put into operation Nov. 1, 1919, at a cost of $110,000, and with the exception of the trouble with odors has been a success. The following is a history of the expedients used and the experiments which led to the present satisfactory installation:

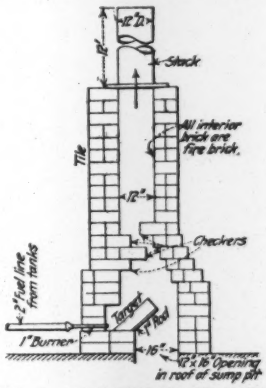


FIG. 1. GAS FURNACE FOR ELIMINATING ODORS

On May 17, 1920, bad odors arose from the open outfall chamber, diversion chamber, sump pit and settling tanks. To remedy this condition the outfall chamber was covered with concrete, the sump pit fitted with a wood and tar paper roof and a 40-ft. stack 30 in. in diameter was erected over the diversion chamber. Instant relief was obtained for the time.

After July 19, 1920, when troubles began again, with the odors at times as bad as ever, the following steps were taken: Conical galvanized-iron hoods were erected over the gas vents to collect the gases from the digestion chambers. The gases were ignited as they passed through the reduced area. On account of foreign matter, tars, gas drip and oil, there was considerable trouble from explosions and finally the burners were abandoned and the gases vented into a 4-in. stack 75 ft. high. The next step was to replace the 40-ft. stack over the diversion chamber by a 100-ft. stack and to cover the settling tanks with semi-airtight roofs in which swing doors were left for rodding and also as a means to jet scum from the top of the gas vents. This procedure removed all odors from the plant and grounds but complaints still persisted, the complainants contending that the gases had only been harnessed and that under certain winds and atmospheric conditions the odors would come from the stacks to the ground level in the vicinity of the plant.

By careful inspection it was concluded that at times the odors in the vicinity of the plant were bad and that if they were not eliminated either the plant would have to be abandoned or the city would have to defend many

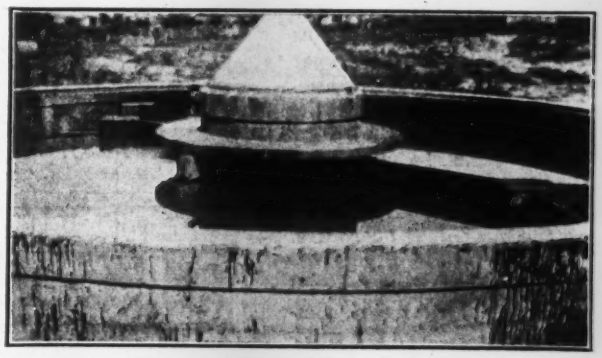


FIG. 2. HOODS TO COLLECT DIGESTED GAS
Scum boards removed to let oils pass over outlet weirs.

lawsuits. The raw sewage odors, which were the predominating odors, occurred in greatest amount during the warmer months. In my opinion the artesian water, which is itself foul when stale, greatly aggravated the situation, although much of the trouble came from oil and tar products from the gas works and several other sources. The gas wastes were cut off and piped into a creek. Most of the scum boards in the tanks were removed to allow the oils on the surface to flow over the weir directly into the effluent. As to the settling effects, the results were practically the same as with the scum boards in place.

The next step was to respond to court summons to show why the city should not be enjoined from operating the plant. Upon showing the court that there was good reason to believe that the odors could be eliminated by a burning process further time was granted during which this contention proved to be correct. In the first experiment on deodorizing the raw sewage odors a tem-

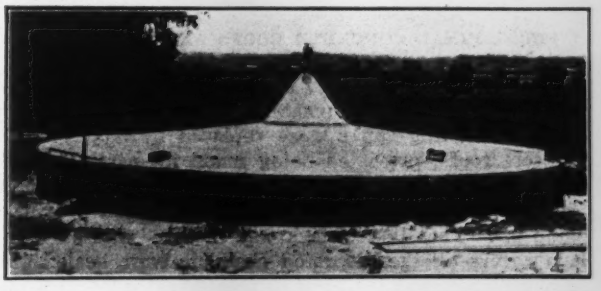


FIG. 3. TAR PAPER ROOF AND HOOD WITH BURNER

porary brick furnace checkered with firebrick was installed on top of the diversion chamber. A suction fan of the type used to suck cotton from wagons at a gin was set up with a 10-hp. motor so as to convey the air carrying the odors to the furnace through a 12-in. galvanized-iron pipe. As a fuel, gasoline was forced through special burners. Results were satisfactory, although the heated firebricks did not reach the degree of heat desired. Nevertheless, the principle was demonstrated.

For a permanent installation an air compressor, distillate burners and a high pressure tank were purchased. A furnace was constructed over a manhole of the diversion chamber. The heat and 100-ft. stack created the necessary draft to suck the sewage air through the furnace. In fact the draft was too strong and the

checkers had to be placed closer together. As long as the distillate was of proper grade the result was satisfactory but occasionally the burners would choke or water would be found in the distillate and then the firebrick could not be kept at the proper temperature. Whenever these things occurred the residents would promptly file their complaints. Further, the process was prohibitively expensive. Distillate cost 20c. per gallon and the monthly cost of operation was $700.

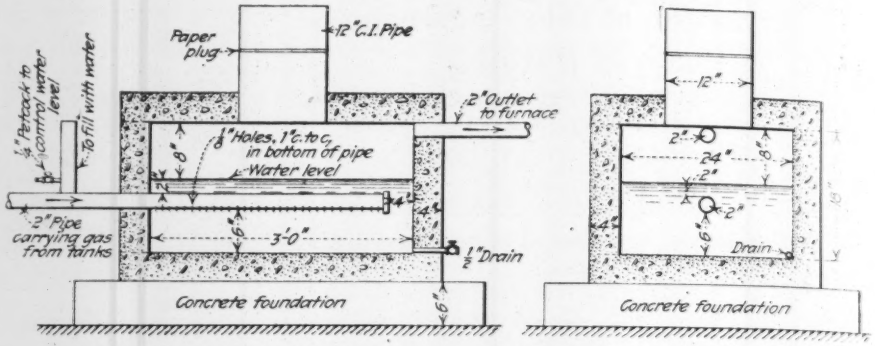


FIG. 4. SECTION OF SAFETY WATER SEAL TRAP

The above described failures brought us to the present plan which has been in successful use for more than eight months without one cent of cost for fuel. Gas from settled sewage arising from the digesting sludge is used as the fuel for the furnaces into which the raw sewage gases are pumped. To carry out this plan it was essential to close all openings over sewage surfaces

FIG. 5. FINAL CONCRETE ROOFS AND GAS PIPING

and to bottle the gases so that they could escape only through the red hot furnace. The temporary covers over the settling tanks were replaced by dome-shaped concrete roofs, provision being made for airtight slots for rodding the sludge and for connections for jetting the scum. A concrete roof was constructed over the sump pit. The 100-ft. stack was removed and all manhole covers on the diversion chamber were sealed. A rotary blower was installed in the pump house to force the air of the sump pit to the furnace, which was located 300 ft. away, near the tanks. The fuel or "digested" gas together with whatever raw sewage gas may arise from the sewage in the tanks is forced by a small gas pump through a safety water seal into the bottom of the furnace. There are sufficient heat units in the gas to keep the furnace red hot at all times. readily deodorizing all small obnoxious gases at small cost.

Since writing the foregoing account certain changes have been made at the plant to increase the efficiency of the deodorization process. The rotary blower did good work but was unable to deliver the gases through the 300 ft. of 2-in. pipe quite as fast as they accumulated in the sump pit. In consequence, at times an odor was noted around the pump room and sump pit. To remedy this condition we moved the furnace, or rather constructed another one on the concrete roof of the sump pit. To this furnace a 12-ft. section of 12-in. galvanized-iron pipe was attached as a stack. A 12 x 16-in. slot was also cut through the roof so as to allow the raw sewage gas to be sucked up into the furnace and through the 12-in. pipe by means of the draft created by the heat and stack. The 2-in. pipe line through which the raw sewage was formerly conveyed to the furnace at the tanks now carries the fuel or "digested" gas, together with whatever raw sewage gas may arise from the sewage in the tanks, back to the furnace at the sump pit. The new installation deodorizes the gases as fast as they accumulate. No longer is the rotary blower used, thus making quite a saving of power. The only power now used is a 1-hp. motor attached to the small gas pump which pumps the settled sewage gases through the safety seal to the furnace.

The writer wishes to acknowledge the valuable assistance of Dr. E. P. Schoch, professor of chemistry, University of Texas, especially with reference to the burning process and safety seals against back fire; also for the practical ideas advanced, later proved correct, he wishes to thank Lee H. Bowles, superintendent in charge of the plant since it was placed in operation.

Provisions of a Recent Cost-Plus Contract

The dam for the new water-supply system of Decatur, Ill., is being built under a cost-plus contract, in which the base price is $700,000 and the contractor's fee is 10 per cent. To this is added a lump sum of $20,000 for plant charges, to cover the use, rental and depreciation of machinery, tools end equipment.

There is an upset or maximum price of $975,000 and a provision for adjusting the base price to the quantities actually placed and at the unit prices bid, provided no changes have been made that would affect these prices. If the actual net cost of the completed work should exceed the base value, the contractor is to be paid as his fee the sum of 10 per cent of the base value, with a deduction from this 10 per cent of 20 per cent of the amount or cost in excess of the base value. But the total deduction is not to exceed 50 per cent of the 10 per cent. Further, if the actual net cost of the completed work is less than the base value, the contractor will be paid as his fee the sum of 10 per cent of the base value, with an addition thereto of 20 per cent of the difference between the actual net cost and the base value.

The contractors are L. N. Cope & Son, Decatur, Ill., and the engineers are Pearse, Greeley & Hansen, Chicago.

Chicago Double-Deck Drawbridge with Elevated Railway

Double-Leaf Trunnion Bascule of 268-Ft. Span—Operating Pinions Engage Racks in Trusses—Massive Truss Members and Supporting Girders

OF THREE double-deck double-leaf bascule bridges built at Chicago within the past six years, forming distinctive structures among the numerous bridges across the Chicago River, the longest is the new Wells St. bridge, shown in Fig. 1, having a span of 268 ft. c. to c. of trunnions and giving a clear channel width of 220 ft. This bridge, put in operation on Dec. 4, 1921, is the second to carry an electric elevated railway on the upper deck. It is of the fixed trunnion type designed some years ago by the city's engineers (but modified by certain patented features, noted later), and is the twenty-third bridge of this type built across the Chicago River. Each leaf is carried by two trunnions and weighs 2,500 tons (1,300 tons of counterweight).

FIG. 1. DOUBLE-DECK 268-FT. BASCULE BRIDGE FOR STREET AND ELEVATED RAILWAY AT WELLS ST., CHICAGO

Next in order of span is the 256-ft. Michigan Ave. bridge, opened in 1920, which has an upper roadway for fast or pleasure traffic and a lower deck for commercial vehicles. Its weight is 3,500 tons for each leaf, including counterweight. The third is the 245-ft. Lake St. bridge, opened in 1916, which carries an elevated railway on the upper deck and is in general similar to the Wells St. bridge, with a weight of 2,000 tons per leaf, including the counterweight. Both of these latter structures have two lines of trusses with two trunnions carrying each leaf. The Michigan Ave. bridge is notable in having four trunnions in four lines of trusses, with a spacing of 6 ft. between the middle trusses, but its width is about 90 ft. as compared with 72 ft. for the other two bridges (see *Engineering News-Record*, Sept. 9, 1920, page 508).

Traffic on the old Wells St. swingbridge was maintained during the construction of foundations and superstructure for the new bridge, except that the roadway on the lower deck was closed for some weeks, partly on account of changes in grade on the street approaches. The program of putting the new bascule bridge into service and removing the old swing span with a minimum of interruption to traffic was given in *Engineering News-Record* of Oct. 13, 1921, p. 606. The new bridge was put in service for the elevated railway on Dec. 4. Fig. 6 shows the north leaf completed except for the deck framing in the end panels through which pass the elevated railway and the street.

Deep Concrete Substructure.—For each leaf there is a concrete tailpit or counterweight pit 48 x 48 ft. inside, with its base 31 ft. below water level in the river, supported on six cylindrical concrete sub-piers built in open wells in the Chicago clay, as shown in Fig. 4. It was intended at first to carry the sub-piers to rock, at a depth of about 117 ft., but this design was modified and they were seated in a hardpan stratum at a depth of about 75 ft. These sub-piers were belled out at the base, increasing the area to limit the pressure on hardpan to 8 tons per square foot, which is the unit adopted for other bridge foundations.

Two piers under the side walls of the pit and carrying the trunnion columns are 10 ft. in diameter, belled out to 18 ft. Two under the front wall or river pier are 11 ft. in diameter and two under the rear wall are 8½ ft. in diameter, these last carrying the anchor columns for the transverse girder which restricts the upward movement of the heel of the bridge leaf.

In the cofferdam for the pit, the bottom course of bracing was supported by jacks on upright posts. During the concreting of the 72-in. floor, which is heavily reinforced to resist upward pressure, the jack supports were moved from place to place in order to avoid leaving holes through the floor. To make the pits watertight, 10 lb. of hydrated lime per bag of cement was added to the concrete and a 1:2 mortar course 6 in. thick was applied in the floor and on the outside of the walls, being carried up with the concrete of the walls.

Trusses, Framing and Floors.—Two lines of trusses, 27 ft. deep c. to c. of chords and spaced 41 ft. 9 in. c. to c., carry two sets of plate-girder floorbeams, at the bottom-chord level and 4 ft. below the top chords, giving a headroom of 14½ ft. above the roadway paving (see Fig. 4). The panel length is mainly 14 ft. 10 in. In general design the trusses are of the parallel-chord type, but with the bottom chords curved downward toward the heel in order to increase the depth at the trunnions and to improve the appearance. An inverted trough

section with outside flanges is used for the top chords, and a double channel section with flanges inward for the bottom chords. Details of the trusses are given in Figs. 2 and 3. Members radiating from the trunnion are of horizontal H-section with lacing over the open sides. A heavy H-section is used for the first vertical post, which takes a bearing on the pier when the bridge is closed. Connection plates are of large dimensions and have curved outlines to improve the appearance, these curves being finished accurately by grinding. Fig. 3 shows the heavy connections at the trunnion. Between the heels of the two trusses is a steel counterweight box filled with mass concrete. Adjustments of weight will be made by means of cast concrete blocks of about 170 lb. each, secured in recesses in the counterweight box.

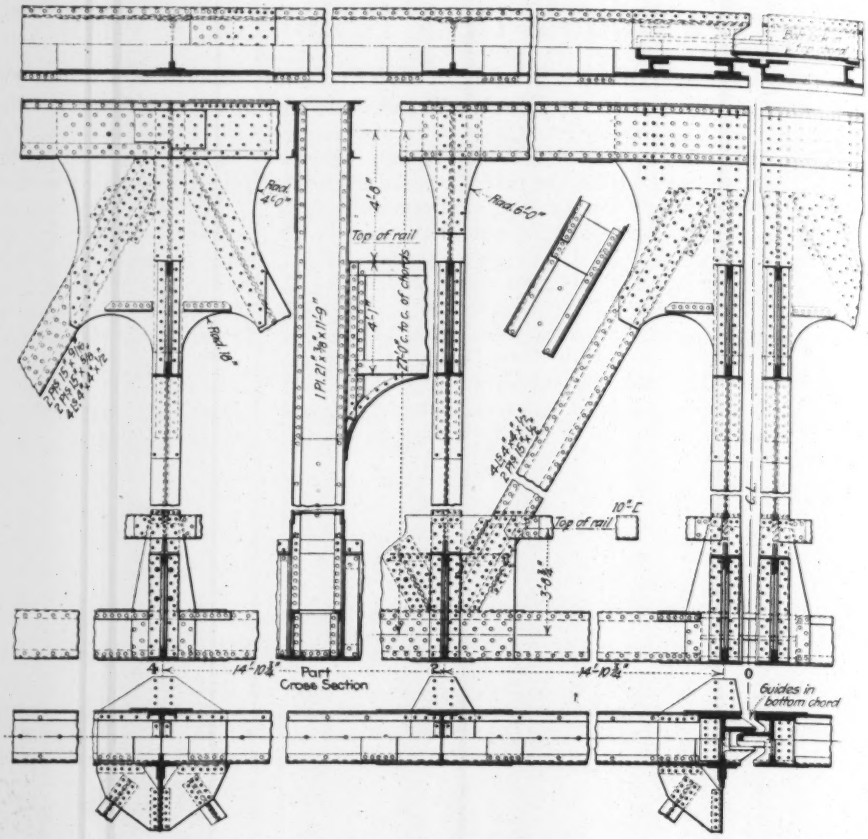


FIG. 2. PART OF MAIN TRUSS, WITH END LOCKS AND GUIDES

Floor framing in the lower deck consists of nineteen lines of 15-in. I-beams between the floor beams, five stringers being grouped under each car track (see Fig. 4.) Cantilever extensions of the floor beams carry timber joists for 15½-ft. sidewalks. For the upper deck there are five 18-in. I-beams, two under each of the elevated-railway tracks. These tracks are spaced 24 ft. c. to c., while the street-car tracks on the lower deck are 10 ft. 2 in. c. to c.

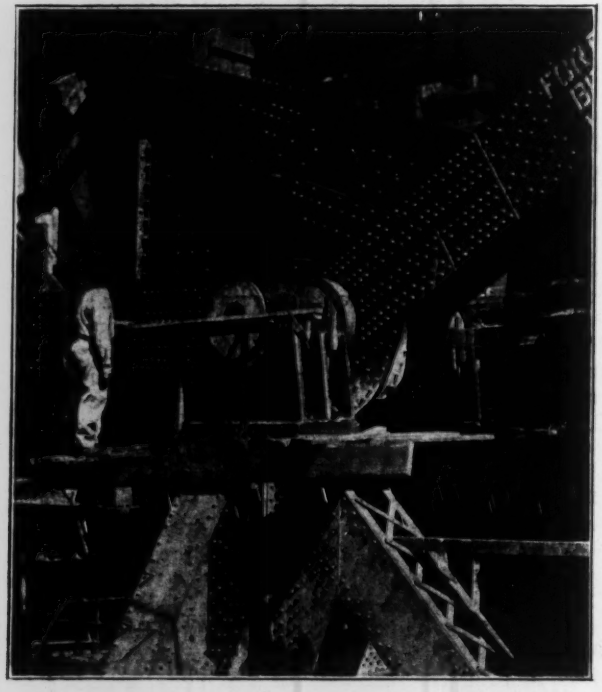


FIG. 3. TRUNNION AND MASSIVE TRUSS MEMBERS

Roadway paving consists of rectangular yellow-pine blocks 3½ in. thick laid on 6 x 12-in. transverse planks, which rest on 4 x 6-in. oak strips on the I-beams and are bolted through the top flanges of these beams. Sidewalks are of transverse planks on wood joists. The upper or railway deck is of the usual open construction, with ties laid across the stringers and carrying track rails with double lines of guard timbers. All timber is creosoted. Grooved girder 129-lb. 9-in. rails for the street-car tracks are bolted to cast-steel saddles riveted between pairs of I-beams, as shown in Fig. 5.

In order to reduce wear, these rails are manganese steel castings for 8 ft. at the end of the leaf and on both sides of the break in the floor at the heel. On the leaf the rails project so as to take a bearing on the end of the opposite leaf. The rail ends are halved so as to give lateral support at the joints in mid span. At the break in the floor at the heel, the 1-in. opening in the roadway is covered by a steel plate set in the recessed face of castings attached to the ends of the approach and leaf. This plate is secured to the approach casting by countersunk rivets. Details of these breaks in the floor are given in Fig. 8.

Live load on the upper deck consists of 50-ton cars of the elevated railway, or 2,000 lb. per lin.ft. for trusses. On the lower deck it includes 50-ton street cars, a 24-ton four-wheel truck and 100 lb. per sq.ft. on the sidewalk and unoccupied space of the roadway.

Trunnions and Supports—In each truss is a forged steel trunnion shaft, having its ends carried in cast-steel

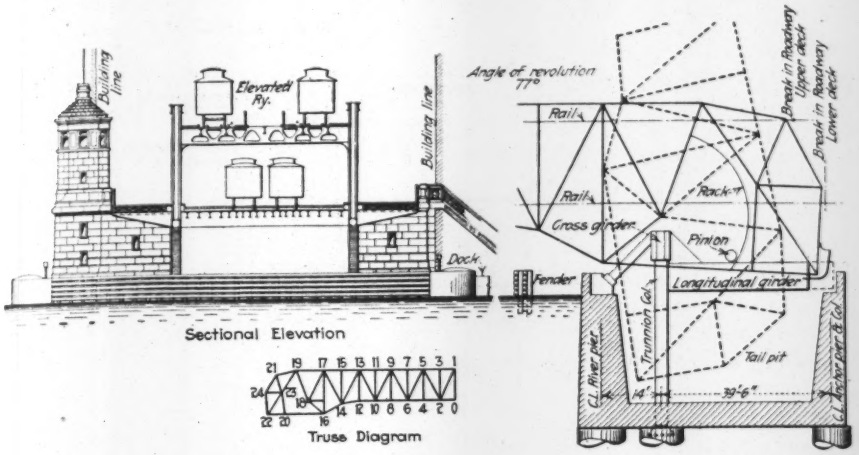


FIG. 4. CROSS-SECTION AND SECTIONAL END ELEVATION

bearing blocks with phosphor-bronze lining. The shaft, bored for the detection of flaws, is 108½ in. long, 29½ in. in diameter in the truss and 27½ in. in bearings. It is made for a light driving fit in the truss and a running fit in the bearings, with allowance for free movement and lubrication. These dimensions are proportioned for a load of 2,500,000 lb. on each trunnion and a unit pressure of 1,250 lb. per sq.in. on the bearings. In setting the trunnions, an accurate base line was established at right angles to the center line of the bridge, and was transferred to a fine piano wire stretched in close proximity to the trunnions, which were then placed parallel to the wire.

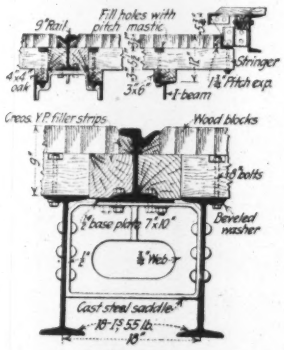


FIG. 5. HIGHWAY DECK AND STREET-CAR TRACK

The four bearings for each leaf are seated on a heavy 79-in. box girder 51½ ft. long, extending across the tail pit and supported on massive columns in the side walls. The ends of this girder pass through the trusses, the members of which are so arranged as to clear the girder in all positions of the leaf. Against the trunnion columns are framed the ends of similar 72½-in. longitudinal girders 39½ ft. long, which are anchored to shoes on the side walls. Brackets or gussets on these girders are riveted to the rear of the cross girder, the forward side of which is braced against the front wall or pier of the pit by a pair of inclined struts. Fig. 4 shows the general arrangement and Fig. 9 gives the details of these heavy girders.

As the longitudinal girders were placed at an early stage of the work to support temporary trusses during the erection of the span, they were built with temporary extension panels 4 ft. 10 in. long to frame against the anchor columns in the rear wall until such time as the side walls of the pit were carried up to the elevation for the shoe bearings. After completion, these extensions were cut off at splices which were provided for the purpose.

In the meeting ends of the top chords are center locks of the bolt type, each operated by a 3-hp. motor on the leaf. In the bottom chords no locks are provided, but the trusses are held in line by projecting lugs on one leaf which enter slotted lugs on the end of the opposite leaf (see Fig. 2).

Tail locks of the toggle type take the live-load reaction on the heel of the closed leaf and also force the bridge down to its final closed position for engagement of the center locks. These toggles are upright, each composed of a pair of levers hinged together, the lower lever being seated in a foot bearing and the upper one entering a cup-shaped lug on the heel of the truss. To release the bridge in order that it can be opened, the toggle is slacked by the pull of a motor-operated horizontal lever, thus drawing the lock member downward and backward so as to clear the lug.

Upward reaction at the heel of the leaf is taken care

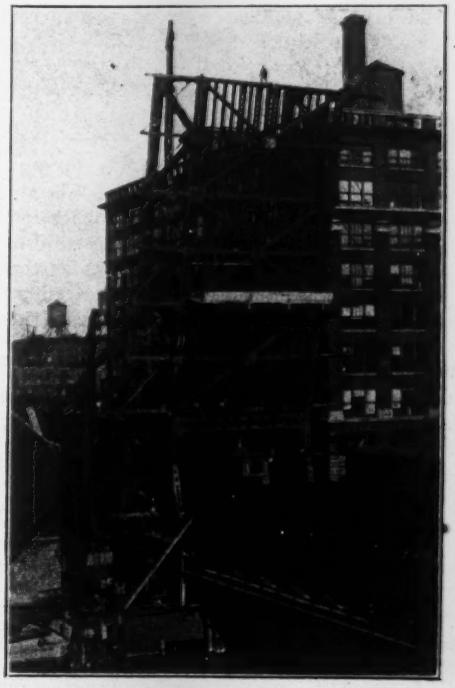


FIG. 6. NORTH LEAF ERECTED WHILE STREET AND RAILWAY TRAFFIC PASS THROUGH LOWER PORTION

of by brackets on the trusses, which engage the bottom of a transverse anchor girder on columns in the rear wall of the tail pit. When the bridge is closed, the bottom chord of each truss takes a bearing on the pier or front wall of the pit, this bearing being directly under the first vertical post or panel point beyond the trunnion. A heavy bearing plate is riveted to the bottom of the lower chord at this point (see Fig. 7).

A pinion and segmental rack for each truss constitute the operating mechanism, the pinion shaft being carried by an inboard bearing on the side wall of the pit and the rack, of 20-ft. pitch radius, being built into

the heel of the truss, as indicated in Fig. 4. The pinion is 17 in. wide, with a pitch of 7 in. and a pitch diameter of 31.2 in. It is driven by a 100-hp. motor through a train of gearing shown in Fig. 9. This arrangement was devised and patented by the late Alexander Von Babo, while assistant engineer of bridges for the city, and it has been used on a number of the river bridges.

Each leaf is operated by two motors and two gear trains. Torsion between the two opposite trusses is resisted by the transverse girders which carry the counterweight box and by similar trusses in vertical and horizontal planes in front of the trunnion. These girders provide sufficient rigidity to enable the leaf to be operated by one motor and pinion if necessary. The machinery is designed to raise or lower the leaves in 45 seconds.

To hold the bridge in any position there is an electrically-operated band brake on the motor shaft, with a similar hand-operated emergency brake on the first countershaft from the motor. Either brake is designed to hold the leaf against a 20-lb. wind pressure. It was at first intended to use grip brakes on the heel of each truss, engaging curved rails on the tail pit, as at the Michigan Ave. bridge. In view of the extra expense it was decided to rely on braking through the machinery, as in most of the other Chicago River bridges.

In addition to signal lamps, gongs and the usual roadway gates of the railroad type, with swinging arms, there will be yielding cable barriers of the Strauss type

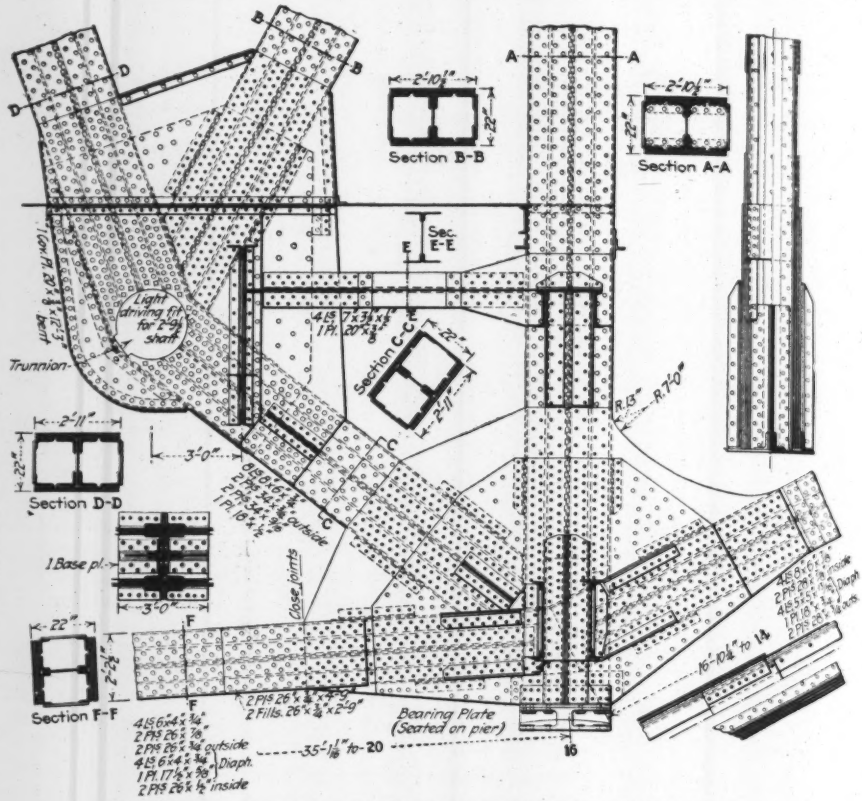


FIG. 7. TRUSS MEMBERS AT TRUNNION BEARING

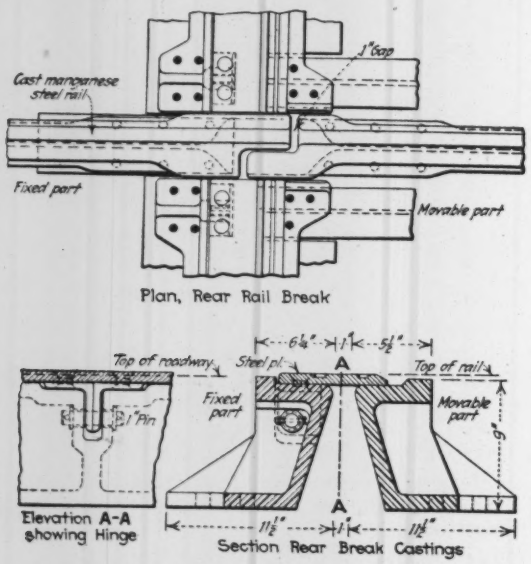


FIG. 8. BREAKS IN CAR TRACK RAILS AND ROADWAY

to close the roadway beyond the large tail pit, which is open when a double-deck bridge is raised. This barrier will be 21½ ft. from the break in the roadway. To prevent undue sag in the cables across the 38-ft. roadway, the center of the barrier will be attached to a light vertical cable wound upon a drum in the framing of the upper deck.

To open the bridge, five motor operations are made in series, as follows: (1) Close roadway gates, (2) lower roadway barriers, (3) release center lock, (4) release heel locks, (5) raise bridge. The electrical mechanism is so interlocked that each operation must be completed before the next one can be made. The bridge is so interlocked with the signal system of the elevated railway as to prevent the center lock being released until the railway signals are set at the "stop" position. Trains on the elevated railway are equipped with devices for automatically applying the brakes and shutting off current if a motorman should pass a "stop" signal.

Operating equipment includes four bridge motors of 100 hp., two heel lock motors of 7½ hp., a 3-hp. motor for center locks, twelve motors for operating gates and barriers and two 15-hp. motors for the tail-pit pumps. Two sources of current are provided for each leaf, from the power systems of the elevated and surface railways respectively.

In putting the new bridge into service, the program differed slightly from that outlined in *Engineering News-Record* of Oct. 13, 1921, p. 606. The elevated-railway traffic was stopped at 8 p.m., Friday, Dec. 2, and the railway forces then began to remove the tracks from the upper deck of the old span and old approaches. The old swing span was swung open at midnight, and

as soon as it was blocked up on the protection pier, work was begun in cutting it apart so that the center portion could be removed to allow the bascule leaves to be lowered. Placing the floor beams, stringers and laterals in the panels left open for passage of trains through the leaves was begun at 9:15 a.m. Saturday.

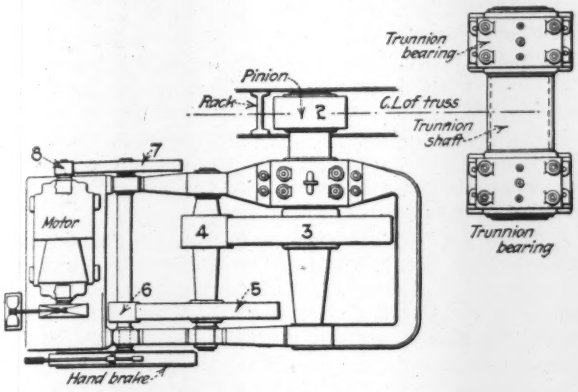


FIG. 9. PLAN OF MACHINERY LAYOUT

This work was discontinued at 5 p.m., for although lights were provided the shadows made it dangerous for the men to work at night. The work was resumed at 6:30 a.m., Sunday, Dec. 4, and was completed by 4 p.m. Both leaves were lowered at 5 p.m.; tracklaying on the upper deck was begun at once. Elevated traffic over the new bridge started at 7 a.m., Monday, Dec. 5.

This bridge was designed in the bureau of engineering of the Chicago Department of Public Works, under the direction of Alexander Murdoch, city engineer; C. F. Healey, assistant city engineer, and Thomas G. Pihlfeldt, engineer of bridges. Its construction is under Clarence S. Rowe, engineer of bridge construction, with F. A. Berry as engineer in local charge; C. F. Harrington, is electrical supervisor. The Ketler-Elliott Co. had the contract for the superstructure, including machinery and erection, the steel being fabricated under subcontract by the Fort Pitt Bridge Co. The FitzSimons & Connell Dredge & Dock Co. had the contract for the substructure, and the Norwood-Noonan Co. had that for the electrical equipment. Since patents of the Strauss Bascule Bridge Co. cover the cross-girder support of the trunnion bearings and the arrangement of members in the heels of the trusses so as to clear the cross girder during the movement of the leaf, the bridge is operated under license from that company.

Lincoln Highway Construction in 1921

Nearly 400 miles of Lincoln Highway were improved in 1921. For new construction $7,700,000 was expended and for maintenance $1,700,000. The additional mileage improved last year represents 12 per cent of the total

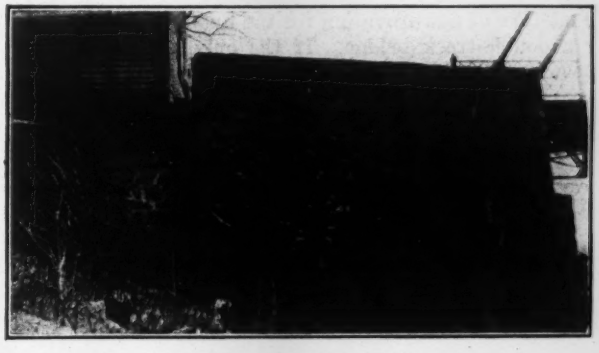
	Miles		Miles
Concrete	521.75	Granite Block	7.10
Brick	241.03	Graded Gravel	1,052.45
Bituminous Macadam	383.28	Natural Gravel	62.10
Macadam	287.10	Graded Earth	526.99
Asphalt	78.00	Natural Earth	136.00
Creosote Block	5.90	Sand	3.30

mileage. Since 1913 when the route was dedicated more than $40,000,000 has been expended on this transcontinental line of 3,305 miles. The surfacing types are noted in the above table.

Failure of Old Bridge Masonry

AN INTERESTING case of progressive failure of old bridge masonry exists at Belvidere, N. J. The east or New Jersey abutment of the Delaware River bridge at that point is cracked, and the outer portion is slowly moving toward the stream. The two views herewith show the north and south face respectively, the latter being stiffened by a heavy buttress, out of which a young tree is growing.

According to Charles A. Mead, chief engineer, Division of Bridges and Grade Crossings of the State Board of Public Utility Commissioners, there is no accurate record of the age of the masonry or of the material on which the abutment is founded. He states that the



CRACKS IN NORTH FACE

abutment is probably about 80 years old, and that the buttress on the south side appears to have been built soon after the construction of the abutment, to counteract bulging of the wall. It is believed that the abutment rests on a layer of slippery material overlying rock, dipping toward the river, and it is not heavy enough to resist the pressure of the fill and the live-load surcharge.

Measurements of the cracks in the two wings of the abutment have been made during the last two years,

SOUTH FACE SHOWING CRACKS AND HEAVY BUTTRESS

after these cracks had been pointed. The cracks increased in width during this period from $\frac{1}{16}$ in. to nearly 3 in.; on Dec. 14, 1921, the main crack in the north wing wall was 2 in. wide, that in the south wing $2\frac{3}{4}$ in.

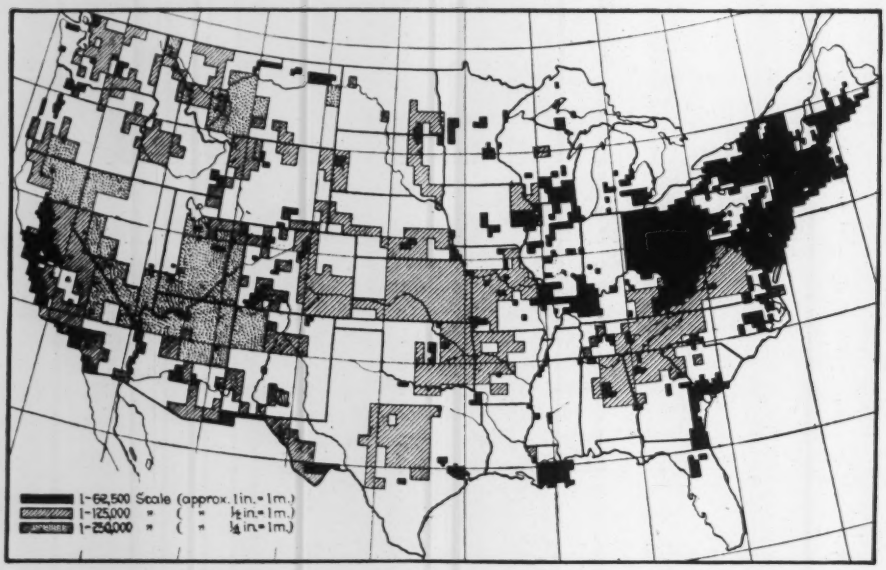
The bridge comprises four spans of lengths ranging from 153 to 169 ft., with trusses 26 ft. deep center to center of chords and 19 ft. apart center to center of trusses. The superstructure, built about 1905, is very light for present-day traffic loads. The bridge is privately owned and operated as a toll bridge. Investigation of its safety for public travel is in progress.

Shall Map Scales Be Decimal or Inch-To-The-Mile?

Present Status of a Question Before Federal Board of Surveys and Maps—Views of Map Users—Cost of Change

By F. E. Bonner
Assistant Chief Engineer, U. S. Forest Service, Washington

SUPPOSE a civil engineer building a bridge should find himself confronted with this problem: The bridge, which is to cost about $100,000, has progessed 20 per cent toward completion when the taxpayers demand that the roadway width should be changed to 16 ft. from 12 ft. originally planned, in order to correct the mistake of not providing for the unquestionable need for a double-track bridge. If the only additional cost caused by the adoption of the amended plan consisted of an expenditure of $200 (0.2 per cent of the total cost) for modifying some of the work already done, would the engineer dare ignore the demand for the change with its undoubted advantages and proceed with the original design? Quite probably not. Yet the proper decision on a parallel problem has been agitating the Federal Board of Surveys and Maps at Washington.



PRESENT STATUS OF TOPOGRAPHIC MAPPING OF UNITED STATES

The question concerns the scale of the standard topographic maps of the United States. All engineers are familiar with the topographic quadrangles published by the Geological Survey. These maps are printed on a scale of 1:62,500 (0.9864 miles to the inch) with some on the smaller scales of 1:125,000 and 1:250,000. No one seems to know why such a scale system was selected in the first place except that it embraces beautifully even multiples of one millionth. It is generally admitted that this attraction hardly compensates for the inherent disadvantages of such a scale, and strong sentiment on the Board of Surveys and Maps is inclined toward the adoption of a change to the inch-to-the-mile scale system. Through various committees the board has been thoroughly investigating the proposal for more than a year.

The chief objection to the present scale is simply that it is meaningless to the average map user and a source of much inconvenience. Specially graduated measuring scales or transfers from the bar scales printed on the maps facilitate their use, but unfortunately the measuring scales employed by practically all map users in this country are divided into inches. The inch is thus used as the unit of measurement on the map and preferably it should represent an integral number of feet or miles, the common units of measurement on the ground. The difference between the two scales is small but sufficient nevertheless to cause much doubt and confusion in the use of the maps. Even in the more expert use made by highway, irrigation and hydro-electric engineers, land classifiers, timber appraisers, etc., the present scale is a source of exasperating uncertainty.

Practice in the Bureaus—Among the government organizations themselves no standard practice prevails at present. Of the principal mapping agencies represented on the Board of Surveys and Maps, five employ mostly decimal scales similar to the 1 : 62,500, while nine use scales on the inch-to-the-mile system. The five using the decimal scales are the Coast and Geodetic Survey, Geological Survey, Lake Survey, International Boundary Commission, and Army. Those using inch scales include the Bureau of Public Roads, Bureau of Soils, Forest Service, General Land Office, Indian Service, Reclamation Service, Hydrographic Office of Navy Department, Post Office Department and Federal Power Commission. Most of the last group have extensive use for the topographic quadrangles and are inconvenienced considerably through the necessity of converting the data to their standard scales on the inch system.

What Map Users Think—From information collected by the Board it appears that the opinion among technical map users—including engineers, surveyors and educators—is strongly in favor of changing the scales to the inch system. An inquiry directed to nearly 1,000 individuals throughout the country representative of the various classes of map users disclosed that 76 per cent believed the change should be made. This expression of opinion included 83 chief engineers of railroads, of whom 53 voted in favor of the inch-scale. The deans of engineering colleges voted in favor of it 42 to 14, state highway engineers 31 to 15, state foresters 22 to 2, city engineers 61 to 13, county engineers 94 to 15, members of the A. S. C. E. 50 to 16; and proportionate majorities in every group of the technical map users solicited for opinion.

The maps have very extensive use by the logging engineers, timber cruisers, foresters and others engaged in the lumber industry. A special investigation of the opinion of this class showed that about 90 per cent considered that the present scale system is a nuisance and should have been discarded long ago. In commenting on the matter J. W. Toumey, Dean of Forestry at Yale

University, states, "It is unfortunate that this scale (inch to the mile) was not established at the outset. Although it will entail some immediate difficulties and some cost, it is my judgment that the change should be made." W. R. Ballard, general manager Somers Lumber Co., Montana, says, "In practical use the present scales are a nuisance." Charles C. Deam, state forester of Indiana says, "I do not understand why they ever used anything else but the scale of one inch to the mile instead of the fraction of mile."

Twenty-two states are co-operating in the mapping of areas within their borders; in ten of these states the co-operating official has been reported adverse to the change, as against three who favor it. However, this argument against the change seems discounted by the fact that a large majority of state highway and state forestry departments want the proposed scale adopted.

Established practice by states, counties and city governments as well as commercial map concerns almost universally embraces the use of the inch scale system, and a large amount of effort is now required for the transfer of the useful data from the government topographic maps on a slightly different scale. Many foreign governments employ a decimal scale system on their maps, but England and Canada, practically the only countries using the same system of measurement as the United States, employ principally the inch scales for their topographic maps.

Other Scale Possibilities—It has been suggested that perhaps a scale of 1:50,000 or 1:60,000 would be preferable to either the inch-to-the-mile or the 1:62,500. The 1:50,000, while excellent for the metric system of measurement, does not fit with the foot and the mile units, which we shall doubtless have with us in this country for a long time to come. The 1:60,000 scale is exactly 5,000 ft. to the inch, and on this account might be favored for a great deal of engineering use; but the greater convenience of the inch-to-the-mile scale for other technical use and for most popular use is paramount.

One of the major arguments advanced against the change is that it would be impracticable to have all the existing maps republished immediately and that during the period of several years while maps on both scales are in use considerable inconvenience would be caused the map-using public due to the sheets not matching perfectly.

Matching Sheets—In this connection it should not be overlooked that the topographic sheets at present are printed on three very different scales. Of the total area of the country mapped so far, 20 per cent is published on the scale of 1:250,000, about 50 per cent on 1:125,000 and only 30 per cent on 1:62,500. There are also a large number of maps on the scale of 2 in. to the mile.

All of the maps cover in the aggregate only about 43 per cent of the country and it is freely admitted that at least half of the work is so old or so much below present standards that the maps are of little value and the areas must be resurveyed. It develops that *less than 10 per cent* of the area of the country is mapped satisfactorily on the standard scale of 1:62,500. About half of this lies in a solid block in the northeast corner of the country. Throughout the rest of the country the area mapped satisfactorily is so small that the anticipated trouble in matching sheets diminishes to almost nothing. In this connection it has been pointed out, too, that the major use of maps is confined to one sheet without reference to those adjacent. There may be a possibility of inconvenience to some map users, but apparently this would be of limited extent and presents no serious barrier to the change.

Cost of the Change—The change in scale will not add to the expense of producing new maps, but to reprint the existing maps to the new scale will require a photolithographic process more expensive than the direct transfer process used now. All of the present maps must be reprinted periodically anyhow, and it is calculated that $100,000 is a fair estimate of the added cost of reprinting the satisfactory old maps to the new scale. This alone constitutes the price which must be paid to clear away the effect of the original mistake of selecting the present scale system.

Reduced to the briefest terms, it may be stated that the inch-scale system possesses such advantages and superiority that the change is favored by the large majority of map users, including government bureaus, state, county and municipal agencies, the technical professions and the public generally, whereas the only factors adverse to the change consist of a possible slight inconvenience during the transition period and an added cost of not to exceed $100,000 for reprinting the existing maps.

Nothing of value can be secured without paying some price and in this case it would seem that the price is less than $100,000. Compared with the benefits and actual money savings that the change will effect this price seems ridiculously small. Many times the amount could be justified easily.

Strong efforts are now being concentrated in support of legislation by which Congress will authorize a meritorious expansion of the mapping program, which will cost in the aggregate about $40,000,000. This great expenditure can be justified only by the usefulness of the finished maps. The voice of the map users is unmistakably in favor of the proposed change of the scale, and the government should be responsive to the opinion of those for whom the service is rendered and who provide the resources to make the accomplishment possible.

In conclusion let us go back to the analogy of the engineer and his bridge. The added cost of about $100,000 for reprinting the old maps is in respect to the total cost proportionate to the $200 required to change the work already done on the bridge, and the advantages of the scale change are proportionate to the benefits from making the bridge width 16 ft. instead of 12 ft. The answer relative to the bridge seems clear, but various complex elements in the scale situation are influencing the majority of the board toward the opposite course.

Manifestly, from the evidence it would seem that a decision could not be other than decidedly in favor of the change with the least possible delay. But before the majority of the board accepts this view it will be necessary, apparently, that the engineers and other map users of the country express their opinion in even more convincing manner.

Decatur, Not Danville

The impounding dam, in the construction of which a moving form was used, as described in *Engineering News-Record* of March 16, p. 452, is at Decatur, Ill., and not Danville, Ill., as was erroneously stated.

Specification Details of Hudson River Vehicle Tunnel

Largest Subaqueous Tunnels in United States to be Built by Compressed Air Shield Method —Some Contract Provisions

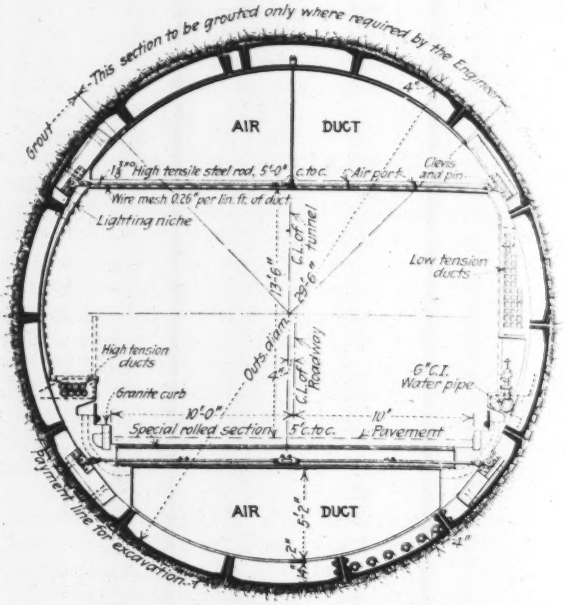
CONSTRUCTION of the Hudson River vehicular tunnel, consisting of twin tubes of cast iron 29 ft. 6 in. in outside diameter and extending from a point at Canal and Spring Streets, New York City, to Jersey City, is provided for in two contracts, designated as Nos. 3 and 4, both of which were awarded to the firm of Booth & Flinn, Ltd., of New York City, March 28. The New York State Bridge and Tunnel Commission and the New Jersey Interstate Bridge and Tunnel Commission are in joint charge of the project.

Contract 3 covers the New York portion of the tunnel and Contract 4, the New Jersey portion. The two contracts were awarded at an aggregate cost of $19,331,724. The tunnel structure specified is "of cast iron or cast steel, lined with concrete." The land-shaft structures consist of reinforced-concrete walls with steel bulkheads and roofs. The river-shaft structures comprise steel walls filled with concrete.

The accompanying drawings show some of the details of the tunnels—which are the largest subaqueous tubes in the United States—while the following notes cover a few of the features of the specifications:

Compressed Air-Work.—The tunnels are to be built by the compressed-air shield method, thus disposing of previously discussed projects involving the trench method of construction and the use of concrete blocks. The air-compressing plants must be capable of furnishing simultaneously to each heading a supply at 50 lb. per square inch pressure equal to at least 15,000 cu.ft. of free air per minute and an additional supply of air at 100 lb. per square inch for operating drills, grouting machines and other appliances. When the air pressure in the heading exceeds 22 lb. per square inch two air chambers are called for, the pressure in the outer chamber not to exceed one-half the pressure in the heading.

The distance from the heading to the nearest bulkhead in operation shall not exceed 800 ft. The carbon dioxide limit in the air is placed at 1 part per 1,000. A safety screen or steel diaphragm with air-tight joints extending from the springing line of the tunnel to the top of the chamber must be kept within 115 ft. of the shield. Two of these screens are specified, so that one



SECTION IN EARTH FOR 29 FT. 6-IN. CAST-IRON TUBE

Provides for 20-ft. vehicle roadway and ventilating ducts at top and bottom.

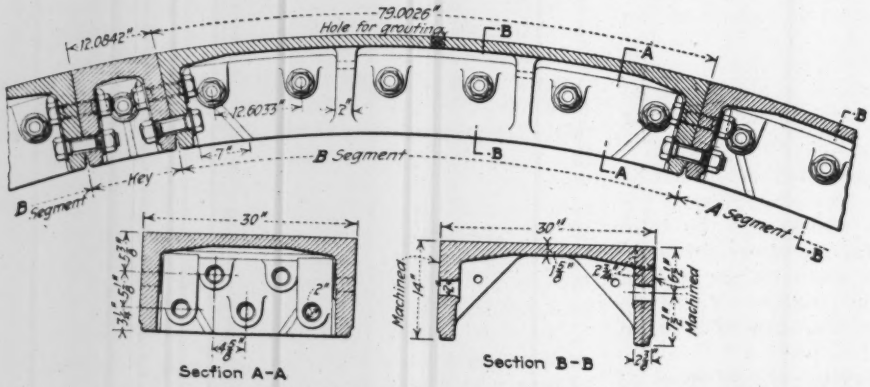
will always be in service while the other is being moved forward. At least two tunnel service tracks between each heading and the nearest bulkhead are called for. Mechanical haulage is specified.

In addition to the tunnel construction proper, which forms the major work of each contract, there is called for, under Contract 3, a river shaft consisting of a steel caisson, with double steel wells filled with concrete, and under Contract 4 two land and two river shafts. The land shafts on the New York side have been completed under another contract and are ready for the erection of tunnel shields.

Where the present river bed is below a plane 55 ft. below high water the contractor must deposit a permanent blanket of clay over the tunnels to the elevation above mentioned.

In the specifications for waterproofing woven cotton fabric treated with asphalt before being brought on the work is called for.

In erecting the cast-iron lining it is specified that all the bolts of the two preceding rings shall be retightened before the erection of the next ring is undertaken.



DETAILS OF CAST-IRON SEGMENTS AND SPECIAL KEY SECTION

Payments to Contractor.—Each contract provides for the retention on monthly estimates of 10 per cent until the amount so deducted reaches a total of $500,000, which is to be held as security for the performance of the contract. Provision is made for paying to the contractor one-half of the retained percentage on his estimates after all the tunnel lining has been erected and compressed air removed. The contractor is entitled to receive in his monthly estimates payment for steel and

cast iron, including tunnel lining, delivered at the work but not incorporated in it, at the rate of $75 per ton for steel, $60 per ton for cast steel, and $35 per ton for cast iron.

The 10-per-cent deduction is not to be applied to payments made to the contractor for plant. The two commissions specify that payment for power plant shall be $250,000 and for shields $250,000 on Contract No. 3, and $250,000 for power plant and $450,000 for shields on Contract 4. The total payments on plant and shields are not to be made until the power plant is in working condition and the shields in operation. After this time 8 per cent of the amounts certified in the monthly estimates will be retained until the total amount paid to the contractor for plant has been deducted.

Under each contract the contractor is required to furnish two bonds, each in the sum of $1,000,000 for the states of New York and New Jersey, or a total of $4,000,000 for both sections of the tunnel. The time allowance for the completion of both contracts is 36 months and a penalty clause, for delay, requires the payment of $1,000 per day.

Clifford M. Holland is chief engineer for the New York and the New Jersey Tunnel commissions.

Limited Installation Space Leads to Special Elevating Equipment

By M. W. Hibbard
Manager of Engineering Construction, The Jeffrey Mfg. Co., Columbus, Ohio

SPECIALLY-DESIGNED elevator equipment was installed recently in the Curtis Publishing Co. plant in Philadelphia to handle heavy rolls of paper from basement level to the various floor levels. Several conditions existed to make the problem one of special study, but it was solved through the design and installation of a chain-type elevator, illustrated in the view herewith. The equipment was designed, manufactured and installed by the Jeffrey Mfg. Co., Columbus, Ohio.

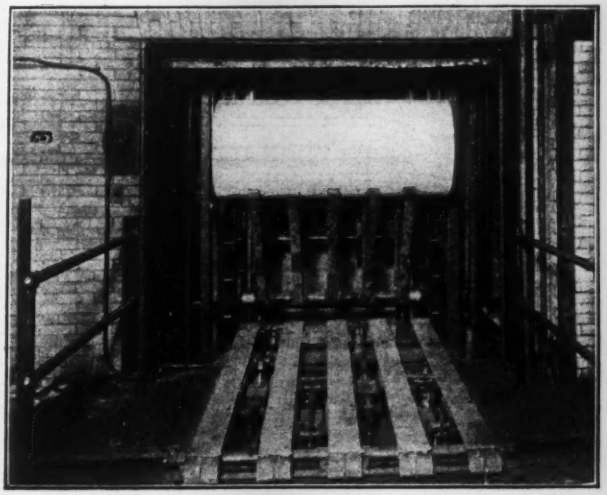
An increase in the amount of paper used made the handling of paper rolls to and from the platform elevator by hand truck increasingly difficult. It was found necessary, therefore, to install some apparatus which would do away with the labor required to put rolls on and take them off the platform elevator and to increase the amount of paper which could be handled per day. No suitable place could be found for the installation of an additional platform elevator. Moreover, the shaft of the existing platform elevator was the only space which could be utilized for new equipment. The installation made consisted of a double-strand chain elevator 178 ft. on centers operating at a speed of about 45 ft. per minute and having a capacity of ninety rolls of paper per hour. The rolls are 27 in., 30 in., and 31 in. in diameter, and from 32 to 68 in. long, weighing from 900 to 1,800 lb. Since the building has to be equipped with fire doors at all openings several features of the installation offered interesting problems for solution.

First of all the handling mechanism had to be so arranged that there would be no possibility of breakdowns or accidents due to attempts to discharge paper at incorrect points; to prevent the handling of paper except it be loaded centrally on the conveyor or rolls of paper larger than the design contemplated; to prevent accidents through the loss of power; and furthermore in case of fire, if fire doors automatically closed up, they would in their turn trip switches which would shut down the conveyor immediately, thus preventing damage to the conveyor, etc.

The elevator is made up of structural framework so arranged as to guide the trays on both the up and down-going paths. It is operated by an electric motor placed at the top floor or the roof of the building. The entire hoisting mechanism is mounted upon a structural steel framework of a heavy and substantial type.

As it was not possible to go below a certain depth in the pit because of possible interference with the foundation of the building, the paper could not be sent by gravity from the basement floor onto the elevator, so it was necessary to install an automatic feeder. This feeder elevates rolls to a sufficient height to allow them to pass by gravity from feeder to the tray elevator. As the tray elevator is forced to deliver on the same side as it ascends, suitable pivoted trays are made equipped with ball-bearing guide rollers run in guides arranged so that paper can be delivered at four different points. At each of these points is a fire door which is closed except during the passage of paper.

As the rolls of paper are very heavy, each must be taken from the elevator as soon as delivered. Provision was therefore made for stopping the elevator until the paper had been removed by the installation of suitable interlocking electrical devices arranged so that the elevator cannot be operated unless one fire door at least is open.



ELEVATOR DISCHARGING ROLL ONTO SKIDS

The elevator itself is made up of two strands of knuckle chain with twelve centrally-hung trays and with shafts arranged to pass through hollow bushings at the articulation point of the chain, thereby eliminating any eccentricity of loading in the chain itself. The lower ball-bearing rollers of the trays travel in guides arranged so as to hold the trays level except at the tripping point, where, by removing a sliding tongue, the rollers pass around curved guides letting the trays trip down and forward, depositing the paper rolls on the incline skids leading into the proper room. The feeder consists of two strands of steel thimble roller chain with one loading tray, the conveyor being arranged to make twelve rotations of the chain to one rotation of the main elevator chain. Thus the single

loading tray keeps in step with the twelve loading trays and deposits the roll at the proper time for each tray to pick it up.

All of the operations of the elevator are controlled by one attendant located at the basement floor. Motive power is furnished by a single unit of 25 hp. driving the elevator through a suitable train of cut-spur gears. The motor is equipped with a solenoid brake. There is also provided on the head shaft a suitable gear lock to prevent reversing of the elevator under load in case the power fails and the solenoid brake does not operate.

Recent Practice in Replacing Trestles by Earth Fill

300,000-Yd. Fill on Missouri Pacific Ry. Is Characteristic of That Road's Consistent Elimination of Deteriorated Timber Structures

EXTENSIVE work in filling large timber trestles on the White River Division of the Missouri Pacific Ry. has been in progress for seven years and a fairly definite practice of making such improvements has been built up in that time. The recent filling of the Georges Creek trestle near Yellville, Ark., a job which required about 300,000 cu.yd. of material, may be taken as a good example of that practice.

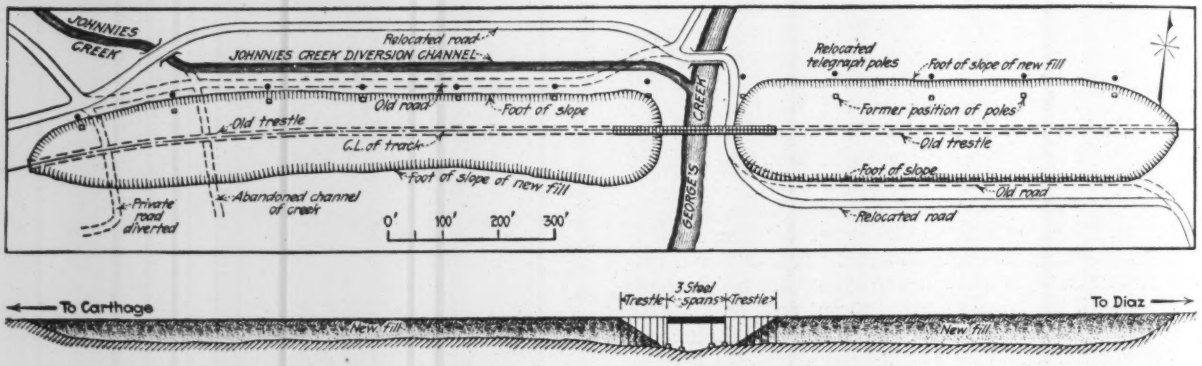
The policy of filling was adopted on the basis of economy in maintenance charges and interest on investment, combined with greater safety to traffic and better control of maintenance on remaining trestles. Insufficient funds made it necessary in some cases to build new trestles in 1921 instead of replacing them with earth fills. However, the extent to which the replacement of timber trestles with earth fills has been undertaken by the Missouri Pacific is indicated by the fact that since 1915 twenty-one trestles of a total length of 12,171 ft., ranging up to 122 ft. in height and requiring 4,528,853 cu.yd. of material, were filled.

The trestle crossing the valley of Georges Creek was the largest on the division, having a length of 2,159 ft. and a general height of 57 ft. It was built of six-post frame bents placed 14 ft. on centers, most of the bents being of three decks. The track deck was solid and covered with 3 in. of gravel for fire protection. The creek itself was spanned by a steel bridge which was left in place after the fill was made. The trestle was built in 1904 and, as it had about reached the limit of its life, either filling in or reconstruction had become necessary.

Filling Operations—The embankment was built by dump wagons working below and trains of dump cars operating from the trestle. Fresno scrapers and dump wagons were employed to form the base of the fill up to a height of about 30 ft. Material for this part of the work was clay and clayey gravel brought from a borrow pit, with a haul of from 50 to 450 ft. An elevating grader hauled by a 40-hp. tractor and a steam shovel with a ¾-yd. bucket were used to load the wagons. About nine wagons were served by the steam shovel and nine by the grader. In addition, twelve scrapers pulled by four-horse teams were used to level the fill.

Clay and rock in proportions of about 70 and 30 per cent were the principal materials handled by cars. Shrinkage averaged about 12 per cent in volume for that part of the fill placed by teams and 15 per cent in that dumped from cars. No slipping or sliding of the fill occurred, nor was there any subsidence of the original surface, as firm earth underlay the fill. Owing to the dampness of the material it took a slope of about 1 on 1½ or even steeper, but the slopes flattened slightly as the material dried. The fill was finished to a width of about 40 ft. at grade line.

For this dumping, the guard timbers, deck fillers and gravel covering were removed. No ties were removed or shifted, as the cars were sufficiently large to throw the material clear of the deck. When the material was at such a height that it would not fall clear, it was leveled by means of a spreader car operated by a separate locomotive. No leveling of material dumped from the trestle was done beneath the deck, but about 30 per cent of this material had to be leveled by the spreader car. Alternate trains dumped on opposite sides of the structure in order to equalize the pressure on the trestle bents. Dumping of the cars was done by hand, requiring a gang of five men on the trestle to release and attach the side chains.

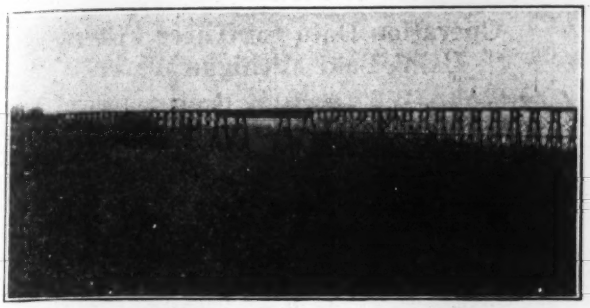


PLAN AND ELEVATION OF THE TRESTLE AND FILL AT GEORGES CREEK

A steam shovel with a 2½-yd. bucket, loaded the material at the pit into 12-yd. dump cars. These were handled in trains of about twelve cars each by the contractor's locomotives, but the railway company supplied the engine crews as the movements were on the single-track main line. The haul was about 3.7 miles. A telephone block system, with operators at the ends of working limits, provided for the protection of work trains against regular traffic, which averaged a total of eight passenger and freight trains daily. About ten work trains were dumped during a 10-hour working day, as an average. From July 27 to Aug. 27, these trains were

operated on two 10-hour shifts, with two 12-car trains for each shift.

Trestle Repairs—The trestle was strengthened at all weak points prior to the commencement of filling. None of the original bracing was removed, since it did not interfere with the operations. A bridge gang was maintained at the structure during the work, to carry out necessary repairs as weak points developed or as the bents settled. This gang also maintained the track in line and surface, placing additional caps or jacking the bents into position, as might be necessary.



GEORGES CREEK TRESTLE

The greatest trouble experienced in all the filling was the sinking of from 2 to 10 ft. of trestle bents during the work. This movement was usually vertical but was sometimes accompanied by longitudinal or lateral displacement. As the bottom sills of the bents could not sink, being on rock or firm clay, the explanation given is that lateral or longitudinal pressure of the fill forced the posts off the intermediate sills, so that they sank in the comparatively loose earth of the fill.

Caps and stringers will be left in place for two years, to allow for settlement and shrinkage of the fill. They will then be removed, the surface of the fill will be brought to subgrade with a width of 20 ft. and on this will be laid the ballast and ties.

BUILDING BASE OF NEW FILL AT GEORGES CREEK

Georges Creek Bridge—Near the middle of the trestle was a steel-girder deck bridge 65 ft. high, over Georges Creek. This bridge was left in place, so that no culvert construction was required. It has a 56-ft. center span with two 28-ft. side spans, all carried by four steel bents. To allow for the slopes of the fill, seven 14-ft. panels of pile trestle were built at each end of the bridge, making 92½ ft. of approach. These approaches have 6-pile bents with 75-ft. creosoted piles driven to rock. A solid deck similar to that of the old trestle is used on these approaches, but the steel spans have an open deck.

Road and Stream Diversions—Under the trestle there was a separate channel for Johnnie's Creek, serving a drainage area of 2,330 acres. A 28-ft. opening was provided by seating one trestle bent on trussed beams spanning between the two adjacent bents. To avoid the necessity of building a culvert, when the fill was made this stream was diverted into George's Creek by a channel 930 ft. long, with a bottom width of 15 ft. and the old channel closed by the fill. In this way the latter creek now serves a total area of nearly 12,000 acres. A public gravel road paralleling the railway was within the limits of the toes of the new fill and 1,600 ft. of it had to be rebuilt outside of these limits. A private road passing under the trestle has been diverted to a new under-crossing beyond the fill at the end of the filled portion of the structure, through a 3-panel pile bridge with grade approaches. A telegraph line had to be shifted to put its poles clear of the new slopes.

Work on the George's Creek fill was commenced July 5 and was completed Nov. 25, 1921. It was done under the direction of E. A. Hadley, chief engineer, Missouri Pacific R.R., and A. F. Dorley, district engineer; with Robert Craig, assistant engineer, in direct charge. The contractors were List & Gifford, Kansas City, Mo.

Safe Haul for Wet Concrete for Roads

THAT strength is but little affected by time of wet-batch haul, up to the time that the concrete ceases to be workable, is indicated by tests made by the Bureau of Public Roads and described in *Public Roads*, December, 1921. Two batches of 1:1½:3 gravel concrete were hauled in six-compartment trucks giving six time-periods for testing as shown by the accompanying table.

Referring to the table it will be noted that whereas the concrete became very dry after about one hour's haul, the strength of the cylinders prepared from the various batches was about the same. In only one case was the strength much below the general average of 3,500 lb. per sq.in. This was in the case of the cylinders made from the concrete in compartment No. 1. Nothing in the appearance of the concrete at the time these cylinders were cast would account for the difference in strength.

RESULTS OF TESTS OF CENTRAL PLANT MIXED CONCRETE

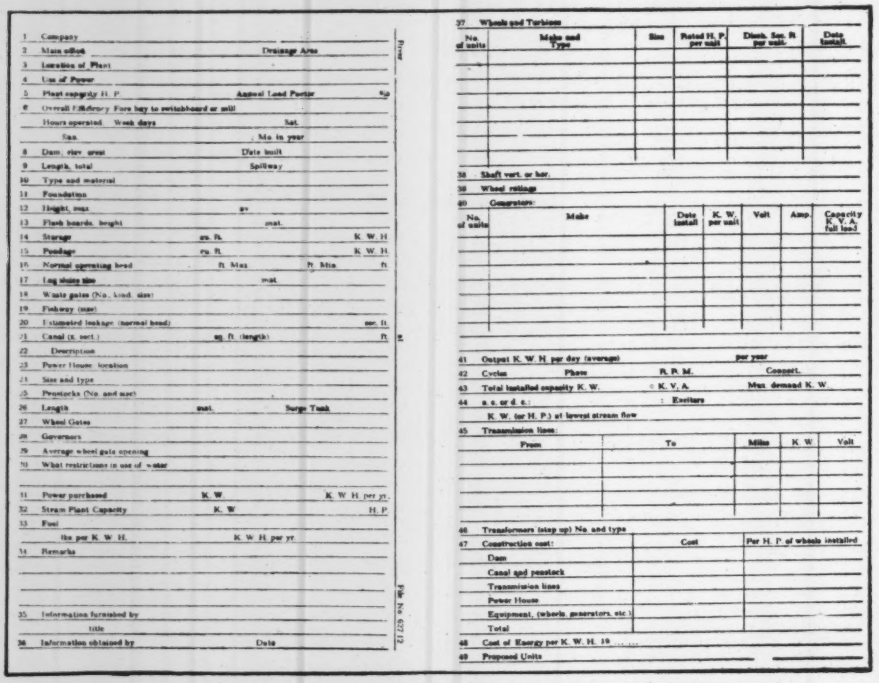
Compartment number	Total elapsed time Hrs.	Min.	Slump Inches	Crushing strength, pounds per square inch (1)	(2)	Average
		15	2	3,620	3,510	3,565
1		45	1	3,460	3,550	3,505
1	1	30	¾	2,670	2,200	2,435
2	1	50	¾	3,510	2,960	3,235
3	2	10	¾	3,820	3,580	3,700
4	2	25	¾	3,110	3,550	3,330
5	2	45	1–16	3,840	4,230	4,035
6	3	10	1–16	3,300	3,370	3,335

The appearance of the concrete during the experiment would indicate that it could have been handled by a concrete pavement finishing machine at any period up to two hours after mixing. It became too dry for hand finishing, however, 45 min. after mixing. Assuming that a wetter mixture would have segregated more quickly, especially with a gravel aggregate, the experiment indicates that the most practical way to utilize the central mixing plant in concrete road construction is in connection with a machine finisher. It also indicates that so long as the concrete is workable after hauling, the strength will not be affected.

Cards and Decimal Filing System Used in Compiling Maine Water-Power Data

BY GEORGE C. DANFORTH
Chief Engineer, Maine Water-Power Commission

DURING 1921 the Maine Water-Power Commission made a water-power census of the state. Estimates previously made in the form of typewritten tabulations at intervals of ten to twenty years became gradually out of date and valueless. It was felt that some system should be used whereby the record could be kept up to date with a minimum of labor and cost. A 5 x 8-in. card was therefore adopted which permitted filing under a decimal system based on geographical location. Both sides of the card are used; the back of the card for *undeveloped* sites being left for a sketch. Where necessary a blank card is attached to the cards for *developed* sites for the same purpose. All cards go into the same file, cards for undeveloped and developed sites being distinguished by white and buff colors, respectively.



WATER-POWER DATA FORM USED FOR DEVELOPED SITES

The form used for developed sites is shown herewith. That for developed sites was used last summer, and so far has appeared to be satisfactory. The form for undeveloped sites has recently been prepared and actual use may suggest possibilities of improvement.

While it would be cheaper to obtain the information desired by correspondence with the power owners an attempt to do this made it apparent that information of little value would be obtained. The cards have been prepared for the use of engineers from this office and nearly every developed site has been visited.

The filing system is that in general use in this office —parts of the Dewey decimal system with such extensions as have seemed desirable. The state has been divided into nine main drainage systems from northeast to southwest, the smaller coastal basins having numbers such as 0.1, 0.2, etc. Each drainage system is further subdivided as necessary, the main river in each case being .0 and the principal tributaries .1, .2, etc., .9 being used for the smaller miscellaneous tributaries. Card indexes are not required and up to the present time the system has appeared to be flexible and practical.

Operation Data for Three Filters Using Lake Michigan Water

COMPARATIVE results of the operation of three rapid filters at East Chicago, Whiting and Evanston, in the vicinity of Chicago, all using Lake Michigan water, as compiled by S. A. Greeley and H. E. Jordan, are given below. The East Chicago plant is rated at 8 m.g.d., the Whiting plant at 4 m.g.d., and the Evanston plant at 12 m.g.d. Coagulant costs were calculated at 2c. per lb. for alum and 0.71c. for lime. Comments on some of the difficulties with short runs at the East Chicago plant during the summer of 1921 are given by Mr. Jordan as follows:

Inspection of the comparative production summary will show a continuous improvement in the operating conditions. Part of this is due to the fact that the demand for water has decreased. The decrease in demand at East Chicago is due partly to the industrial let-down, but we feel that it is more especially due to the campaign which the company has been carrying on warning the people against waste of water, which beginning with Sept. 1 was all paid for on a meter basis.

In the earlier days of the operation our runs were very brief and various methods of washing were tried, including the Ellms "breaking" method. At that time this procedure did not give satisfactory results. The reasons were not altogether apparent but it now appears that it was due in part to the use of an insufficient amount of coagulant. The material which was deposited upon the sand layer at that time was dark in color and the "breaking" method produced incipient mud balls. On account of their formation, "breaking" was abandoned for the time being. A gradual increase in the amount of coagulant followed through the various months up to April when for four months an average of 2.2 gr. of alum per gallon was applied. At that time it was noted that the material which was washed out of the filter had a decidedly lighter color than in the earlier days. This fact would appear to mean that the material carried into the filter was more largely a pure aluminum hydrate of slow settling rate, the darker material taken from the lake water having settled very largely in the basin with the use of the increased amount of coagulant.

Beginning in the middle of June, as a result of definite indication of air entrainment in the sand layer,

a modification of the "breaking" method was again put into use. This scheme has finally resulted in a procedure along the following lines: The inlet valve of the filter is closed and the water is allowed to filter down until there is from 6 to 12 in. remaining above the sand layer. The air is allowed to exhaust itself, and the wash-water valve is then opened for an interval not to exceed 15 or 30 sec., applying wash water at a rate of about 3½ in. vertical rise per minute, producing a renewed release of air from the sand. This "breaking" is continued six or eight times until the slight application of wash water produces no more air release, when the filter inlet is opened and the unit replaced in service.

COMPARATIVE PRODUCTION SUMMARY OF THREE FILTER PLANTS USING LAKE MICHIGAN WATER

	East Chicago							Chemical, Gr. Per Gal.		
	—Run in Hours—									
	No. Runs	Av.	Min.	Max.	Yield per Run, M.G.D.	Wash Water, %	Yield, % Rated Cap.	Alum	Lime	Coag. Cost per M.G.
1920										
Nov.*.....	885	3.1	1.4	7.0	0.180	16.4	100	0.5	...	$1.40
Dec.....	1,100	4.3	0.5	13.0	0.294	16.7	130	0.6	...	1.86
1921										
Jan.....	1,182	3.6	1.0	10.2	0.273	11.1	130	0.9	...	2.74
Feb.....	625	6.2	1.7	16.8	0.406	7.8	114	2.0	...	5.60
March.....	570	7.4	2.5	15.0	0.440	5.7	101	1.9	...	5.44
April.....	611	7.7	1.2	17.8	0.372	5.2	94	2.2	...	6.24
May.....	519	8.0	1.5	27.8	0.428	4.9	88	2.2	...	6.26
June.....	281	14.8	2.8	154.2	0.795	2.8	89	2.2	...	6.26
July.....	59	71.4	51.8	135.2	4.130	1.0	96	2.2	...	6.26
Aug.....	62	67.1	49.2	74.8	3.352	1.6	84	1.5	...	4.30
Sept.....	60	64.5	49.2	72.3	2.680	2.1	67	0.8	...	2.52
Oct.....	50	73.3	47.1	93.9	2.942	1.9	58	0.8	...	2.52
Nov.....	44	78.6	44.3	161.2	3.269	2.1	59	1.7	...	4.84
Dec.....	46	72.5	54.8	95.6	3.089	2.8	57	2.1	...	6.04

* Plant started 6 p.m., Nov. 11, 1920.

	Whiting									
1921										
Jan.....	....	8.0	4.0	15.0	.....	....	100	1.5	0.7	$5.01
Feb.....	....	9.4	4.1	19.2	.....	5.9	98	1.4	1.0	5.02
March.....	....	7.3	4.2	15.0	.....	5.9	95	1.4	1.1	5.12
April.....	....	4.8	3.1	7.2	.....	8.4	94	1.6	1.2	5.79
May.....	750	6.3	3.6	10.1	.165	7.7	100	2.0	1.2	6.41
June.....	653	7.0	4.7	10.9	.177	7.5	96	2.2	1.5	6.34
July.....	371	14.5	11.8	16.8	.305	5.3	91	1.4	1.0	4.35
Aug.....	427	10.4	8.0	14.3	.247	6.5	84	1.5	1.0	4.46

	Evanston									
Dec.....	....	87.2	28.3	144.0	.....	1.2	38	0.7	...	$2.00
Jan.....	....	74.9	14.1	144.0	.....	1.6	37	0.7	...	2.00
Feb.....	....	77.0	28.0	144.0	.....	1.3	40	0.7	...	2.00
March.....	....	32.7	12.9	47.7	....	2.5	43	0.7	...	2.00
April.....	....	20.3	7.4	59.5	....	2.6	48	0.7	...	2.00
May.....	145	24.0	8.8	62.6	1.37	2.1	55	0.7	...	2.00
June.....	170	13.1	5.9	23.4	0.69	2.5	60	0.7	..	2.00
July.....	149	33.0	6.4	143.5	1.63	1.3	81	0.7	...	1.98
Aug.....	112	37.1	12.8	71.5	2.85	1.9	52	0.7	...	2.00
Sept.....	132	33.0	10.6	71.7	1.35	2.4	45	0.7	..	2.00

Following this operating procedure the filters were washed completely every third day. These washes are quite long, about 10 min. at a 24-in. rate. The successive air releases produce an accumulation of coagulant upon the surface of the filter that gives a somewhat fuzzy appearance when looking down through the water above the sand. It is also noted that some irregular cracks develop late in the series of partial runs, but this is, however, accompanied with no deterioration of the effluent, and the entire procedure seems to be a safe operating basis for water similar to that of Lake Michigan where the quantity of dissolved oxygen is relatively high and the suspended material in the raw water low. The bacterial efficiency of the plant was surprisingly good throughout the summer months.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Specifications for a Good Engineer

Sir—The engineering profession should thank you for publishing on page 435 of your issue of Mar. 16 the extract—too brief probably—of Prof. H. E. Riggs' address at the University of Michigan. There are many fundamental ideas pertaining to the ethics of the engineer with which everybody is familiar but which need to be clothed in fresher garb occasionally that they may be better remembered. Many of us are prone to forget that there is something beyond the mere "getting of a new job," and it should not take sixty years for one to learn that it pays to be honorable. Wendell Phillips used to say that it required that length of time for a politician to learn to tell the truth.

Unfortunately not all of the "scalawags, liars and rattlesnakes" referred to are on the bottom rung of the profession, but—let us thank "whatever gods may be"—they are in the minority. When one calls to mind the honorable course always pursued by men like the late Frederic P. Stearns or the late Richard M. Berrian, to say nothing of others still among us, one feels that the specification for an engineer as laid down by the late Chief Engineer Starling may still be filled:

"A good engineer must be of inflexible integrity, sober, truthful, accurate, resolute, discreet, of cool and sound judgment; must have command of his temper, must have courage to repel and resist attempts at intimidation, a firmness that is proof against solicitation, flattery or improper bias of any kind; must take an interest in his work, must be energetic, quick to decide, prompt to act; must be as fair and impartial as a judge on the bench, must have experience in his work, and in dealing with men, which implies some maturity or years; must have business habits and a knowledge of accounts. Men who combine these qualities are not to be picked up every day. Still they can be found. But they are greatly in demand and when found they are worth their price; rather they are beyond price, and their value cannot be estimated in dollars."

FREDERIC I. WINSLOW,
Framingham, Mass., Mar. 22. Consulting Engineer.

Sliding, Saturation Studies, and Repairs of Low Earth Dam

Sir—So little is written on the behavior of earth dams that the following may be worth publishing. The dam in question is about 30 years old, having been raised twice by adding material to the crest and lower slope.

The upper limit of saturated material was probably for some years as indicated by the dotted line AB, Fig. 1. In time the slope of the line of saturation raised to the position indicated by line AC. At this stage considerable seepage appeared. Next a longitudinal crack appeared near the downstream edge of the crest and parts of the lower slope moved outward and downward.

The remedy applied is indicated in Fig. 2. A ditch parallel with the dam was made at F. Numerous laterals E from it lead in to meet seepage and drain the toe of the embankment. This was intended to and did lower the line of saturation to the line marked AD, thereby strengthening the overlying material against sliding. Finally the sloping banquette indicated in the sketch was built of good clay in 6-in. layers, placed with dump wagons. The remainder of the lower slope was repaired. The result so far is that seepage is negligible. No further cracks have appeared and there is no more sliding of the lower slope.

It is believed that the strengthening of the dam is nearly

permanent and that it was accomplished with a minimum of material and labor and is safer construction, as well as more economical, than one with the whole lower slope uniform.

The straight lines here shown indicating saturation of the dam are *nearly* correct representations. The writer's

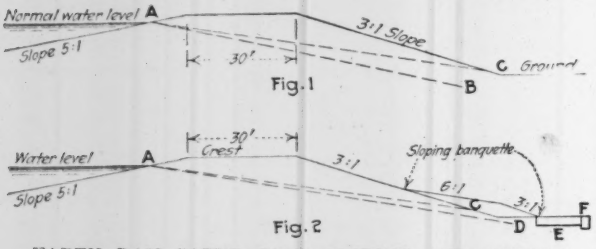


Fig. 1

Fig. 2

EARTH DAM SATURATION, SLIDING AND REPAIRS

experience in sounding earth dams for saturation supports the belief that the line of saturation is most often a reverse curve, the first part being above the straight average line and the lower part below it.

A good indication of the safety of an earth dam can usually be had by inspection and sounding along the toe of the lower slope to find how much solid earth is above that which is saturated and unstable.

Earth dams are worth more serious study and more extensive use. Too often elaborate structures of concrete and steel, or stone or timber, are erected at great expense when properly protected earthwork would be more economical.

Mechanical equipment and common labor can generally provide a mass of earthwork at very low unit costs. Some care will be required with either type of dam but any important dam would have about the same expense for attendance, no matter what type is adopted. If capital charges are lessened appreciably, the earth dam ought to be more carefully considered. Comparatively speaking, earth dams are easily and cheaply built anywhere by local labor and can always be strengthened or repaired the same way.

Generous proportions, protection from erosion, and intelligent supervision are requisites. GEORGE C. LOVE

Newport News, Va., March 9.

Effect of Solid and Pneumatic Tires on Soft Sub-Grades

Sir—In H. W. Slauson's letter published in the Dec. 15 issue of *Engineering News-Record*, p. 994, he mentions the fact that the unit pressure of the air within a pneumatic tire is the same as the unit pressure of the tire on the road surface. Is that correct? Suppose a water pipe full of water to be resting on the ground. Then the unit pressure of the pipe on the ground is obviously the same (neglecting the slight elasticity of the pipe and the water) regardless of the pressure of the water within it. Because the elasticity of rubber and air is greater than of iron and water the results in the case of the rubber tire are nearer to Mr. Slauson's statement, but still incorrect.

Mr. Slauson also neglects entirely the effect of impact which may amount to five or eight times the superimposed load in the case of the solid rubber tire (as shown by tests of the U. S. Bureau of Public Roads) and certainly not more than twice the superimposed load in the case of the pneumatic tire. M. P. SMITH,

Massachusetts Institute of Technology.

Cambridge, Mass.

[To Mr. Smith's letter Mr. Slauson makes the following reply.—EDITOR.]

Sir—Thank you for your favor in calling my attention to Mr. Smith's reply to my letter on solid and pneumatic tires, which was published in the Dec. 15 issue of *Engineering News-Record*, p. 994. I am glad of the opportunity to point out a peculiarity surrounding the conditions of pneumatic-tire operation which may not generally be known.

Mr. Smith's analogy of the iron pipe filled with water cannot be used in this case, for the iron pipe itself is self-sustaining and the water pressure is not used to carry any load. If we consider a pneumatic tire as primarily a collapsible tube, filled with air, which is used to sustain the load, it is obvious that the area of contact of that tire under a given load is solely dependent upon the inflation pressure within the tube. If we have a sustaining pressure of 100 lb. per square inch within the tube and carry a load of 100 lb., we will have 1 sq.in. of road contact. If the load carried by the tire is doubled, the area of contact will be doubled, for the sustaining pressure of the air within the tire which serves to keep the rim away from contact with the road will be the same. Of course, there is more or less inherent stiffness in a pneumatic tire, but this is not a point necessary of consideration, inasmuch as this stiffness is merely used to protect the air-containing tube from wear and punctures.

Were area of contact not directly proportional to the load applied, the weight carried on a tire would increase the air pressure within that tire. This we know is not true, for it is no easier to inflate a tire carrying 100 lb. pressure if the wheel is jacked up from the ground than is the case when it is carrying its full load. Applying weight to the tire does not increase the air pressure within the tire, but it does increase the area of contact.

It is for this reason that the rutting effect of a large truck pneumatic tire is greater than that of a cushion tire, inasmuch as inflation pressures of such truck pneumatics are much higher than the normal loads per square inch of contact of wide cushion tires.

Mr. Smith is correct in his remarks on impact, but such impact variations are noticeable only at comparatively high speeds of travel. My letter, to which Mr. Smith refers, discussed primarily the effect of contractors' trucks on soft sub-grades and incompleted road surfaces, in which case the speed, whether on solid tires or pneumatics, would not be above 8 or 9 miles per hour.

Another interesting viewpoint on the subject of impact has been brought to light by some road tests made in California under exceptionally heavy truck traffic. These tests have indicated that impact with solid truck tires is not a serious factor, unless obstructions of 1, 2 or 3 in. in height, or depressions of an equal depth, are encountered. This is further supported by the fact that all of the tests made by the U. S. Bureau of Public Roads were over obstructions or depressions measuring 1, 2 or 3 in. in height. A well repaired, hard-surfaced road contains no such obstructions or depressions, and consequently the matter of impact is not as serious as many of us had first supposed. HAROLD W. SLAUSON,

New York, Jan. 16. Engineering Service Manager, Kelly-Springfield Tire Co.

Torch for Submarine Metal-Cutting

Sir—In reading the description of the patented electric torch used in cutting out the broken section of the 36-in. water-supply pipe under the Narrows to Staten Island (See *Engineering News-Record*, March 2, p. 346), I was reminded of a similar apparatus which recently came to my attention. This is an ordinary autogenous welding and cutting outfit employing oxygen and a combustible gas with the addition of an annular jet of compressed air which is projected from a hood over the nozzle of the burner and surrounds the operative flame. The air is at such pressure as to create a water-free space within which the flame is kindled by means of an automatic igniter. The air jet is projected parallel to the flame and impinges on the work forming an impenetrable mantle against the water. The air wall is at such a distance from the flame that the latter is undisturbed by its action.

It is asserted that the above apparatus has been employed quite extensively and successfully in Europe in the cutting of sheet piling and the salvaging of sunken ships, operating in water to depth of 100 ft. It is claimed that this outfit will cut between 8 and 30 in. through ½-in. plate per hour, depending on the clearness of the water.

The above torch is patented and manufactured by the Deutsche-Luxemburgische Bergwerks, A. G. Dortmund, Germany. ALBERT FRIEDMANN

Wyomissing, Pa., March 9.

NEWS OF THE WEEK

New York, April 6, 1922

Probably No Present Action on Muscle Shoals

Congressional Committeemen Indicate That All Offers Will Go Over This Session of Congress

(Special Correspondence)

Members of the Senate Committee on Agriculture and the House Committee on Military Affairs have returned to Washington, after an inspection trip to Muscle Shoals, Ala., in connection with the offers made by Henry Ford, Alabama Power Co., Frederick E. Engstrum, and Charles L. Parsons, for various purchase, lease and construction methods of disposing of the government war-time nitrate projects and the future disposition of the hydro-electric developments in that region when and if completed.

Observers traveling with the party report that the net result of the inspection trip will probably be that nothing will be done at the present session of Congress toward a definite disposition of the Muscle Shoals projects. Senator Norris, chairman of the Senate Committee on Agriculture, stated to a special correspondent of *Engineering News-Record* with the party that the plan of the Senate committee, after making the inspection, will be to try to obtain from Congress at the present session as appropriation of at least $7,500,000 to have the work continued by the government for at least one year. This, he said, includes continuing the work of building the Wilson Dam and possibly Dam No. 3 and installing in the Wilson Dam power house the four units of machinery now on the ground and mostly already paid for, sufficient to produce 120,000 kw.

View of House Committee Members

On the other hand, members of the House Committee on Military Affairs express the determination that so far as they are concerned not another dollar shall be added to the $106,000,000 already expended by the government in connection with the Muscle Shoals projects until the final disposition of the present and any possible future investment is determined. This means a deadlock in Congress. In addition, Senator Norris states to *Engineering News-Record* that so far as the Senate is concerned the calendar of unfinished business in the Senate is already so great that irrespective of any other proposals such as his plan to have the government complete the dams not sufficient time remains for action on either the Ford, Alabama Power, Engstrum or other offers, and that these will have to go over until the December session.

During the inspection trip, it was plain to those traveling with the party, from the speeches of the senators and representatives, that the Ford offer was losing favor. Senators and members of the House frankly and openly criticized the real estate promotion schemes which were in evidence in connection with the attempt to bring Mr. Ford to Alabama.

There is about $5,000,000 worth of construction plant and contractor's equipment on the ground, ready for any agency to put to work, and most of it, according to the engineers, is still in good condition, and every effort is being made by them to keep it so. It was pointed out to the investigators, however, that the coffer-dam, which is of pine, will not last much longer.

On the works there is the following equipment: Seven 10-ton Terry cranes which were in use until May of last year being kept painted and in good condition; three 10-ton McMyler full circle cranes in good condition; three air-compressor plants on the south side of the Wilson dam being kept bright and polished; eleven steam shovels from Nitrate Plant No. 2, which have had hard service and are in the open but are being maintained as well as possible; 129 rock drills in good condition; seven gyratory rock crushers in fine condition; twenty-six standard-gage locomotives, boarded up and greased; seventy-nine remade box cars in fair condition; sixty-five flat cars, in fair condition; sixty 20-yd. dump cars, being kept painted, in fine condition, as well as fifteen standard-gage gondolas, also in good condition; twelve locomotive cranes, standard gage.

Hudson River Bridge Charter Granted

On March 31 Governor Miller of New York signed the bill incorporating the Bear Mountain Hudson River Bridge Co., organized to build a highway suspension bridge across the Hudson from Anthony's Nose, 3 miles above Peekskill, to Bear Mountain, connecting the east-shore and west-shore highways leading from New York to Albany. The project for this bridge was outlined in "Engineering News-Record" of Feb. 23, p. 236.

A 1,650-ft. span is contemplated. The crossing is to be operated as a toll bridge. Amendments to the original bill place the tolls under supervision of the Public Service Commission and fix a purchase price at either cost plus 10 per cent or stipulated sums (quoted in the articles referred to). The bridge is to become the property of the state in any event after 25 years.

Frederick Tench, of Terry & Tench, Inc., contractors, who has been one of the main promoters of the project, states that construction will begin at once, in the expectation that the required congressional authorization will be obtained. It is believed that the War Department is prepared to approve the project substantially as outlined.

Civil Engineers Fail To Choose Secretary

Action Postponed — Hovey Elected Treasurer—New Committee Activities—Federation Deferred

(Engineering News-Record Staff Report)

At its meeting in Dayton, Ohio, April 3 and 4 the Board of Direction of the American Society of Civil Engineers failed to take the long-awaited action of choosing a secretary, despite extended discussion. Various candidates were suggested and it was finally decided to postpone action until the next meeting at the June convention to give time for circulation of names within the board, and full study. Selection of an assistant secretary also was deferred. The board, however, filled the office of treasurer, Otis E. Hovey being elected.

Two other important questions—affiliation with the Federated American Engineering Societies and accepting advertising in the society's publications were taken up, but put over for fuller information. The latter question was held to require further investigation while on joining the federation the incomplete expression of views of local sections was not considered to supply sufficient information for present action.

New Committees Named

A foundation was laid for important new society activities by the creation of several committees, chief among which is a Standing Committee on Professional Conduct to consist of three members of the board to investigate and report on all cases of alleged violation of ethics. Five special research committees were authorized on steel stresses, hydraulic phenomena, irrigation engineering, highway-bridge impact and flood protection. A by-law, to be acted upon at the June meeting, was introduced to allow organization of technical divisions of the society.

Further progress in committee work was recorded through organization of two technical committees as follows:

On Fire Prevention: Chairman, B. B. Hodgman, J. F. Coleman, John Meigs, R. P. Miller, W. W. Pagon, E. L. Soule, Benjamin Thompson.

On Electrification of Steam Railways: Chairman, C. F. Loweth, Bion J. Arnold, George Gibbs, G. W. Kittredge, E. J. Pearson, Samuel Rea, Robert Ridgway.

The board accepted the invitation to joint sponsorship in organizing the International Engineering Congress at Philadelphia in 1926.

Appointment of H. H. Quimby to succeed H. J. Burt on the Engineering Standards Committee was announced by the president. The board decided to hold the fall meeting in San Francisco, Oct. 4 and 5; the chief subject of discussion will be "Power."

Am. Soc. C. E. Student Chapters

According to information contained in its *Year Book*, published February, 1922, the American Society of Civil Engineers has 45 student chapters.

Motor Vehicles Number 10,448,632

With returns received from all States, the U. S. Bureau of Public Roads reports that the motor vehicle registration in the United States for the year 1921 totaled 10,448,632. This represents an increase of more than 1,000,000 over the 1920 figures. No State reported a registration less than the 1920 figures. The total amount collected as fees of various kinds amounted to $122,478,654.

These figures supersede the preliminary statistics published in these pages March 16, p. 460.

Oppose Vehicle Weight Increase in Maryland

Chairman John N. Mackall, of the Maryland State Roads Commission, has filed a protest against a bill, pending before the General Assembly of Maryland, which provides for an increase in the maximum gross weight of motor trucks from 20,000 to 25,000 lbs. He points out that the measure would increase the load per inch width of tire from 650 to more than 800 lbs. In his protest Chairman Mackall calls attention to the fact that when the roads were subjected to the heavy loads which were carried during 1918 many of them were destroyed but since then, under a 20,000-lb. limitation, there has not been a single failure on any state highway.

Large Power Grant on Kings River, California

On March 29 the Federal Power Commission approved the granting of a license to the San Joaquin Light and Power Corporation to develop a comprehensive power project on the North and West Forks of Kings River, Fresno County, California. An ultimate installed capacity of 266,000 hp. is contemplated. The Division of Water Rights, California, has issued a permit to the applicant to use the natural flow of the streams. The project contemplates the storage of 204,000 acre-ft. of water, but a permit for this cannot be issued until the rights of water users have been established by the state. The commission, however, approved the granting of a license for the project in so far as it relates to the natural flow of the river. The estimated cost of the project is $51,000,000.

Electric System Consolidation in Los Angeles Proposed

The city of Los Angeles and the Southern California Edison Co. have joined in a petition to the California railroad commission for permission to transfer the local electrical distribution system of the Edison Co. to the city. The price agreed upon is $11,000,000. The agreement provides for the preferred sale and purchase of power between the parties, the private company retires from local service and the city protects the company from competition outside city limits. For some years the city has desired to add this distribution system to that which now distributes power from the hydroelectric plants on the Los Angeles aqueduct. Litigation preventing this has only recently been closed and bonds sold with which to complete the transaction.

Commerce Commission To Consider Railroad Consolidation

Consolidation of railroads into a limited number of systems will be discussed at a hearing to begin on April 24 before the Interstate Commerce Commission. The first sessions will be devoted to the roads in the Southeastern region. This hearing will be the first action of the commission in this matter since the adoption of its general plan last August.

Water-Supply Project for Akron Industries May Proceed

A decision of the State Supreme Court of Ohio, affirming the decision of a lower court, will permit the State Superintendent of Public Works, whose office is at Columbus, to proceed with plans for a dam on the Tuscarawas River South of Akron to supply water to industrial plants in South Akron. The storage will be additional to that now afforded by the Portage Lakes. It is expected that the industries to be benefited will buy a $750,000 state bond issue to finance the project.

Decision on Railroad Rates Not Expected Until April 15

The decision of the Interstate Commerce Commission in the matter of a general reduction in railroad rates, it now appears, will not be forthcoming before April 15. At present the case is being studied by the commissioners individually. If they should find themselves in substantial accord the decision probably could be handed down as early as April 15, but should there be important differences between them it obviously will extend the time required for the consideration of the case.

Tennessee Issues New Rules for Motor Vehicles

The following traffic rules have been adopted by the Tennessee State Highway Commission:

1. Maximum load shall not exceed 650 lb. per inch width of tire; the tire width to be taken as the inside width of tire channel.

2. Maximum gross load shall not exceed 10 tons.

3. Solid rubber tires for gross loads less than 6,500 lb. on one axle shall have a minimum thickness of ¾ in.; and for gross loads in excess of 6,500 lb. on one axle shall have a minimum thickness of 1 in.

4. Maximum speeds for trucks shall be as follows:

Under 2-tons gross load, 20 miles per hour.

From 2 to 6 tons gross load, 15 miles per hour.

From 6 to 10 tons gross load, 12 miles per hour.

5. All traction engines and tractors must remove all cleats from the wheels, or by some other method protect the highway surface from damage in passing over any improved state highway.

6. Violations of these rules will be prosecuted under the provisions of this act.

7. Each maintenance patrolman is given police authority to enforce the provisions of this act as above outlined.

Arrangements have been made for the purchase of jack scales for the enforcement of the rule regulating the maximum gross loads of auto trucks.

Five Indicted in Knickerbocker Theater-Failure Case

As a result of the inquest held in Washington over one of the victims of the Knickerbocker Theater collapse (see *Engineering News-Record* of recent issues) five of the nine individuals held by the coroner's jury were indicted by the grand jury on a charge of manslaughter. The other four were exonerated of any criminal negligence in the theater failure and the resulting loss of 98 lives.

Those indicted are: Reginald W. Geare, the architect of the Knickerbocker theater; John Howard Ford, general manager of the Union Iron Works, who designed and furnished the steel roof framing; Richard G. Fletcher, at the time the theater was built Washington manager of the Hammett Fire Proofing Co., contractor erecting the hollow-tile walls; Julian R. Downman, District inspector of reinforced concrete, and Donald Wallace, general foreman for the builder of the theater.

The four exonerated were: Morris Hacker, at the time of the theater construction head of the District building department; Thomas L. Costigan, a former computer in the District building department who checked and approved the Knickerbocker plans; John L. McDonald, steel contractor, and Frank L. Wagner, the general contractor on the Knickerbocker construction.

Besides returning the manslaughter indictment the grand jury recommended that the District building code be revised to clarify ambiguous and conflicting clauses and to make specific changes regarding the construction of larger buildings particularly wherein public gatherings are to be held. The grand jury also recommended that Congress make larger financial provision for the operation of the District building department to the end that adequate salaries be allowed and a sufficient number of computers and inspectors be at all times available to perform the work required of the bureau.

As reported from Washington the theory of the prosecution is that the five men held "were engaged in a gigantic task which required that each know what the other was doing, what it was his business and duty to do, and were so related in these duties that they knew or ought to have known whether each performed properly his portion of the work, and if it was neglected or negligently performed."

New York State Assumes More Control of Water Power

Governor Miller, of New York, has signed an amendment to the state water power act which gives much more power to the state in control of water power development than it has hitherto claimed. These amendments first permit the state to recapture powers for which permits have been granted and on which no development work has been done and second, allow the state to control to whom power is sold and the price at which it is sold. The provisions apply to any water-power under the jurisdiction of the state, which broadly speaking is all power developed on navigable waters or state lands or which would affect state lands by change of flowage, etc.

A. A. E. Directors Hold Quarterly Meeting

To Improve Employment Service—Offer License Law Amendment—Officers Nominated

Improved employment service to the isolated members of the American Association of Engineers was decided upon March 24 at the quarterly meeting in Chicago of the board of directors. It was proposed to employ several field secretaries to develop the employment service, organize new units, serve old ones and facilitate co-operation among the various chapters, clubs and assemblies. To make this plan feasible the executive committee was directed to submit a budget and plan at the annual convention at Salt Lake City, June 5, 6 and 7.

The chapters were urged by the board not to send instructed delegates to the convention and also to reduce the expenses of the convention by consolidating representation in the proportion of one delegate to 250 members.

LICENSE LAW AMENDMENT

An amendment to the model license law was made which would grant a registered engineer from an outside state permission to practice for 90 days without registration or fee provided he files a copy of his home-state certificate of registration together with information as to his address, intention to practice, date and time of engagement. Another change would provide that engineers employed by partnership or corporations may sign and seal the plans prepared by the partnership or corporation.

D. W. Patton, chairman of the legislative committee, reported that from early replies in a recent study, engineers' license laws were functioning well in Arizona, Idaho, Florida, Louisiana and Minnesota. In Pennsylvania and Tennessee the laws go in effect this year. A central enforcement bureau is desired by some Louisiana engineers. The Pennsylvania law has been criticized as too stringent; under the new Arizona law, which is optional, except for state and county engineers, about 10 per cent of the engineers have already been licensed.

A recommendation was sent to President Harding that an engineer be appointed to fill the vacancy existing on the U. S. Civil Service Commission. A. B. McDaniel was endorsed for appointment to the position.

A consolidated balance sheet of 125 chapters reporting to the auditing committee, C. A. Hoglund, chairman, showed a net cash surplus of $21,240.96 and total assets of $33,320.70.

PRACTICE COMMITTEE REPORTS

The practice committee, of which H. W. Clausen is chairman, reported on seven cases. One case condemns the practice of selling companies offering commissions to city engineers and states that members should be expelled if employed or connected with the management of such a company. In another case it was held unethical for an engineering firm to accept bonds that by law must be sold at par and accrued interest in payment for engineering work where it is necessary for the engineering firm to base its charges on the sale of the bonds at less than par and accrued interest. The question of "intent to defraud" must be decided prior to determining the penalty. It was ruled not ethical for a partner in an engineering practice to sell his share to the other partner, establish a new firm and attempt to secure the clients of the old partnership.

While higher salaries for engineers in teaching service are favored, under present business conditions it was in the opinion of the board, inopportune to publish a final report on a schedule even as high as the tentative one published in 1920. Prof. C. J. Tilden is chairman of the committee.

OFFICERS NOMINATED

The following nominations for officers were announced: President, Clarence W. Hubbell, A. N. Johnson and A. M. Van Auken; first vice-president, George E. Taylor, (A. S. Morris, withdrawn); second vice-president, A. M. Knowles and O. Laurgaard; directors, District 2, C. A. Heinze; District 3, B. W. Matteson; District 8, W. S. Boyle and F. B. DeFrees; District 9, D. Q. McComb, Frank T. Payne, W. M. Poyton and Charles F. Wheelock; District 11, C. Arthur Poole.

To Report Federal-Aid Road Bill

(Washington Correspondence)

Appropriations for a two-year highway program only will be provided in the bill which the Committee on Roads will report to the House of Representatives. The Committee has approved a bill which will carry an appropriation of $65,000,000 for the next fiscal year and $75,000,000 for the fiscal year to end July 1, 1924.

The Committee insisted on placing a proviso in the bill which will limit federal aid to $12,500 per mile of road during the next fiscal year. The limit for any year thereafter is to be fixed in the bill at $10,000 per mile of road. To this proviso there will be strenuous objection on the part of the states. It is possible that this limitation can be eliminated from the measure on the floor of the House. It is regarded as practically certain that it will be unacceptable to the Senate.

Newark Public Health Institute

A Public Health Institute under the auspices of the U. S. Public Health Service, the New Jersey Department of Health and the Health Department of the City of Newark will be held in the city just named, April 10 to 14. Among the addresses will be one by Allen Hazen, consulting engineer, New York City, on water supply, at 10 a.m., April 11, and one by M. N. Baker of the editorial staff of *Engineering News-Record* on sewage disposal, at 1:30 p.m., April 12. Dr. Charles V. Craster, health officer of Newark, N. J., is acting director of the Newark Public Health Institute.

Next A. P. H. A. Meeting To Be in Cleveland Oct. 16-19

The next annual meeting of the American Public Health Association will be held in Cleveland, Ohio, Oct. 16-19. To be sure of consideration, copies of papers which it is desired to present at the meeting should be in the hands of the Program Committee by July 1. Such papers should be accompanied by abstracts of 200 words. The secretary of the Association is A. W. Hedrich, 370 Seventh Ave., New York City.

Chicago Engineers Discuss City's Problems

Western Society and Local Sections of Eight National Societies Hold All-Day Convocation

Under the joint auspices of the Western Society of Engineers and the Chicago sections of eight national technical societies the city's numerous engineering problems were discussed March 22 in an all-day convocation. While the hall was not crowded, different groups came and went as the different topics came up. It was the first time in many years that day meetings for technical discussions have been held by the local societies. The co-operation evinced by the many prominent engineers of the city in leaving their business, was the subject of much favorable comment.

L. A. Ferguson, vice-president of the Commonwealth Edison Co., and H. H. Clark, consulting engineer of the Peoples Gas Light & Coke Co., outlined the province of their respective utilities.

Clarence W. Farrier, city planning engineer, Board of Local Improvements, gave a concise review of the work on the Chicago Plan of the late D. H. Burnham. He brought out the practical engineering features and classified the various projects according to their relative usefulness. Jacob L. Crane made a plea for a regional plan which would encompass northern Illinois, southern Wisconsin and a portion of Indiana.

"Railroad Transportation in Chicago" was handled by E. J. Noonan, chief engineer, Chicago Terminal Commission. He outlined the present situation and the numerous plans of the various groups of terminals. Among railroad officials who followed Mr. Noonan in discussion were E. H. Lee, president, Chicago & Western Indiana R.R.; A. J. Hammond, assistant chief engineer, Chicago Union Station Co., and C. H. Mottier, office engineer, Illinois Central.

URBAN TRANSPORTATION

Col. Bion J. Arnold, in his talk on "Urban Transportation" said that the keynote now is co-operation instead of competition. The startling suggestion was made that the Union Station Co., build all of its structures of the same height so as eventually to provide a landing place for aerial traffic.

Harry L. Brown, western editor, *Electric Railway Journal* and *Bus Transportation*, in discussion claimed that Chicago had one of the best urban transporation systems in the country and with municipal support instead of constant harassing could be greatly improved. Bus traffic on the north side now numbers nearly 10,000,000 passengers per year and the buses travel 1,750,000 miles per year. It is only a beginning and does not compare with other forms of transportation, in his opinion. He suggests that non-stop high-speed bus service from the loop to several outlying, thickly populated centers would doubtless soon be a reality. The great desirability of having all transportation service under a unified control was emphasized for a stabilization of financial standing.

Col. John J. Millis outlined Chicago's water-borne transport possibilities.

At the annual dinner, Reed Landis spoke on "Aerial Transportation" in Chicago and David Kinley, president, University of Illinois, on "Engineering Opportunities."

American Firm To Rebuild Louvain Library

Memorial Structure Designed by New York Architects to be Gift of America to Belgian People

Contract for the reconstruction of its famous library building which was destroyed by the Germans during their march through Belgium in 1914 has been awarded by the University of Louvain to the Foundation Co. of New York. Plant and materials are to be assembled immediately. This work which will cost somewhat more than $1,000,000 is considered to be one of the most important single pieces of reconstruction yet put in hand in the devastated area.

NEW LIBRARY AT LOUVAIN, GIFT OF AMERICA TO BELGIAN PEOPLE

Warren & Wetmore of New York are the architects for the library which is to be rebuilt on a new site two blocks distant from that of the old structure. The corner stone was laid with appropriate international ceremonies July 28, 1921. The building will be in the style of the Flemish Renaissance and will be surmounted by a tower that will rise to a height of 275 ft., dominating the surrounding country. The main structure will be 220 ft. long and 150 ft. in depth. The material to be used is a local white stone together with red brick, blue slate roof and copper flashings, certain details of the facade being gilded as is usual with monumental structures in Belgium. The tower will contain *carillon*, or chimes, which will sound the national airs of the several allied nations.

In order to care for the books that are piling up in Louvain to replace those that were destroyed the first section to be begun will be the stacks, which it is estimated will be ready in about eighteen months. Ultimately the library will house two million books and will have a seating capacity of three hundred readers together with class rooms and administrative offices. It is planned to complete the library by 1925, the five hundredth anniversary of the erection of the original building.

This structure is a gift from the American people to those of Belgium. Funds are being raised in this country by the National Committee of the United States for the Restoration of the University of Louvain, of which Dr. Nicholas Murray Butler, president of Columbia University, is chairman.

Highway Engineer Gets $10,000 for Injuries at Storm King

After having his claim in every court of record in the state, and having secured an enabling act from the legislature to prosecute, Dudley P. Babcock of Albany, New York, former engineer in the employ of the state highway department, has secured a $10,000 award from the Court of Claims for injuries received while in the discharge of his duties.

At the time of the preliminary surveys for the state highway along the Hudson River it was necessary for Mr. Babcock to be lowered in a sling from the edge of Storm King Mountain. The rope parted and he fell many feet and was severely injured.

Reconstruction Hospital Breaks Ground for Addition

Reconstruction Hospital, New York City, broke ground Sunday, April 2, for its new eleven-story addition at 100th St. and Central Park West. The total cost of the new annex will be $1,500,000.

No Truth in Rumor That New York Engineers Must Register Soon

Major Percy E. Barbour, vice chairman of the New York State Board of Licensing for Professional Engineers and Land Surveyors, announces that no foundation exists for the rumors that have been circulated in and around New York that in order to avoid examination engineers must apply for licenses before an early date. This date has varied, one of the earliest rumors having named Dec. 31, 1921, and the latest setting May 1, 1922.

As the law now stands it will be unlawful to practice engineering in New York State after May 5, 1923, without a license. The Licensing Board has authority to require examination of any applicant whose qualifications and fitness the board may consider it advisable to determine in that manner. There is no way to avoid such an examination by filing an application before any particular date.

To Honor Meade, Engineer Officer and Victor of Gettysburg

Ground was broken last week in the National Botanic Gardens, Washington, for a memorial to General George Gordon Meade, the victor of Gettysburg. The Secretary of War presided over the ceremonies, the first spadeful of earth was turned by President Harding and the second by Chief Justice Taft. Governor Sproul of Pennsylvania, George Gordon Meade, grandson and George Gordon Meade, 3d, great-grandson also participated.

The memorial, a gift of the Commonwealth of Pennsylvania, will be by Charles Grafly, a Philadelphia sculptor, and will face that of General Grant now in the Botanic Gardens.

General Meade was an officer in the Corps of Engineers, U. S. Army with the rank of Major General of Volunteers during the Civil War.

May Abolish or Consolidate Office of State Engineer

A concurrent resolution empowering the New York Legislature to consolidate the offices of state engineer and surveyor and of superintendent of public works was passed by a recent session. The resolution has to be passed by the legislature of 1923 and approved by a referendum vote of the electorate of the state before it becomes effective.

Under the terms of the resolution, the legislature may abolish either or both of the offices named. If the office of state engineer and surveyor is abolished, this action becomes effective on the expiration of the term of the incumbent of the office at that time. If the office of superintendent of public works is abolished, this takes effect at such time as the legislature may specify. With the abolition of this office would also go that of the assistant superintendent of public works.

If either of the two main offices named is abolished, then "the legislature may vest in another officer, by the same or different name, the statutory powers and duties of the officer whose office shall be thus abolished, subject to modification of such powers and duties by the legislature." The legislature of 1924 would be the first one that could take action under this concurrent resolution in case it becomes effective.

River Tunnel Costs Compared

Comparative costs of the Hudson River vehicular tunnel, for which the contracts were awarded last month, and the rapid transit tunnels under the East River, New York City, let prior to the war, are the subject of a brief report by C. M. Holland, chief engineer to the New York-New Jersey tunnel commissions, from which the following extract is taken:

"The comparative actual cost of the vehicular tunnels is only about 10 per cent greater than the tunnels contracted for in 1914. In detail, the average bid price for the vehicular tunnels for cast-iron lining is almost precisely the same as the prices received for constructing the rapid-transit tunnels. Cast-iron in the case of the vehicular tunnels will be about 27 per cent of the total cost as compared with 30 per cent in the case of the rapid transit tunnels. The estimated cost for excavation for the vehicular tunnels is about 44 per cent of the total cost of the work as compared with 50 per cent in the case of the rapid transit tunnels. The average unit cost for excavation for the vehicular tunnels is $21.30 per cubic yard in 1922 as compared with $20.40 per cubic yard for excavation for the rapid transit tunnels in 1914.

"I submit the above in connection with the query which has been made a number of times as to what relation present-day prices bear to pre-war prices in connection with the vehicular tunnels. In consideration of the above, the question arises as to whether costs on account of general business conditions and general reduction of prices have dropped nearly to pre-war level, or whether the larger tunnels are cheaper per unit of cross-sectional area. In my opinion, the extremely favorable prices received are due to a combination of conditions as just stated."

Highway Traffic Association to Hold Annual Meeting

The annual meeting of the National Highway Traffic Association is to be held at the Automobile Club of America, New York City, May 12. The afternoon and evening sessions will be devoted to a consideration of the reports of the following national committees: uniform highway signs, traffic capacity and widths of highways outside of municipalities, standards of the construction of highway curves and recommended practice to increase safety to traffic, highway-improvement creed, regulations governing speeds, weights and dimensions of motor trucks and trailers, licenses and motor-vehicle taxation, highway-transport franchises, and highway-transport clearinghouses.

An informal dinner will be served at the Automobile Club between the afternoon and the evening sessions.

Elmer Thompson, 247 West 54th St., New York City, is the secretary of the National Highway Traffic Association.

Hearings on Zoning at Detroit

The City Plan Commission of Detroit, Mich., has tentatively adopted a zoning ordinance and map after a series of conferences with various organizations in the city. Before submitting this tentative ordinance to the Common Council for final adoption, hearings are to be held in various parts of the city.

Offer Made to Operate Nitrate Plant 1 at Muscle Shoals

A proposal to operate Nitrate Plant 1 at Muscle Shoals with the first 100,000 kw. of secondary power has been submitted to the Secretary of War by Charles L. Parsons, secretary of the American Chemical Society. The offer has been sent to Congress by Secretary Weeks.

Dr. Parsons proposes to form a company to be known as the Southern Nitrate Co. which will in turn organize the Southern Nitrate Corp. whose securities will be underwritten and offered at public subscription. The company, or its successor, proposes to purchase all of the property constituting (officially) Plant 1 for $600,000 and to manufacture therein nitrogen by the Haber process or some modification of it.

For power the company would pay 0.75 of a mill per kilowatt-hour, delivered at the switchboard, for power delivered ten months per year, and a proportionate price for such a part of the 100,000 hp. as may not be available for the full period.

Dr. Parsons would also lease the carbide plant of Nitrate Plant 2 together with its physical appurtenances for $50,000 a year, and would either lease or purchase outright the Waco Quarry. That part of Plant 2 acquired would be used for the manufacture of calcium carbide, and phosphoric acid and potash. In case the government should lease the cyanamid, ammonia oxidation or ammonia nitrate portions of Plant 2, Dr. Parsons agrees to furnish the lessee calcium carbide required for cyanamid or fertilizer production at a six per cent profit, power and nitrogen gas to be furnished at cost.

Massachusetts Committee Report Favors St. Lawrence Project

A committee of nine appointed several months ago by the executive committee of the Associated Industries of Massachusetts to report on the St. Lawrence River waterway project has submitted the following conclusions: 1. That the project is feasible from an engineering standpoint; 2. That it can be constructed at a reasonable cost, considering the magnitude of the work involved; 3. That it will furnish a direct and usable water route between the ports of the Great Lakes and both foreign and domestic ocean ports; 4. That in the very near future this nation will require every possible means of transportation by water, rail, and motor, and that accordingly the St. Lawrence project will be of great assistance in reducing otherwise necessary expenditures for additions to our rail facilities, and greatly lessen the inevitable transportation crisis which will arise with a restoration of normal business and the natural growth of the country; 5. That it will give to New York and New England a very large, reliable, and cheap source of hydro-electric energy; and, 6. That the project is desirable for the country as a whole, and beneficial to New England.

The committee consisted of Charles R. Gow, chairman; Charles A. Andrews, F. B. Crosby, George L. Finch, S. Harold Greene, Henry I. Harriman, William P. Libby, Edgar J. Rich, and A. B. Tenney.

Indiana Water-Works Annual Meeting Is Held

Damage to Water Systems by Not Using Fire Engines—Little New Work Now—Pollution Topics

Alleging that a destructive action takes place when water pressures throughout the entire system are raised to fight fires, the Indiana Sanitary and Water Supply Association, at its annual meeting, March 22 and 23 in Indianapolis, went on record against the practice. Fire engines, for local pressure increases, were preferred. The same arguments were advanced at the recent meeting of the Iowa section of the American Water Works Association and the same records of broken services and mains and increased leakage were recounted at both meetings. Many Indiana fire departments having fire engines do not use them, thus jeopardizing the whole supply. Fire departments act on the theory that it is easier to let the water-works for the whole city do the work. Several other papers on fire service were presented at the meeting. Dow R. Gwinn, president, Terre Haute Water Co., led a round-table discussion on the subject.

Construction at Low Point. — J. B. Marvin, vice-president, Frankfort Water Co., in a round-table discussion on water-works building programs in Indiana, stated that the $800,000 being spent on the Hammond municipal plant was the largest work under way. J. W. Toyne, South Bend, had written to 30 cities asking for a record of contemplated work. Not a single city had anything but maintenance planned.

Pollution. — The Calumet district came in for much discussion, the distribution of the enormous lake pollution by the industrial plants being noted in a paper by L. A. Geupel, director water and sewage, Indiana State Board of Health. John C. Diggs, engineer, State Department of Conservation, is attempting to obtain a yardstick of pollution. He cited the population density of the watersheds of the rivers of the states as one factor.

Paul Hansen, consulting engineer, Chicago, explained the iron-removal experiments, not yet concluded, at Benton Harbor. An absorption tower, aerators, lime and alum treatment, sedimentation and reaction chambers and final filters are included.

W. C. Mabee, assistant chief engineer, Indianapolis Water Co., presented design data and unit costs on the 10-m.g. reinforced-concrete reservoir, 10 ft. deep, which was built in four months last season at a cost of $223,500.

J. B. Marvin was elected president and C. K. Calvert, Indianapolis, secretary-treasurer, for the ensuing year.

Exhibitors at Water Works Convention

According to a statement recently given out by John S. Warde, chairman of the Water Works Manufacturers' Association, forty-four firms have so far signified their intention of exhibiting at the American Water Works Association convention to be held in Philadelphia May 15 to 19. The majority of the firms have applied for booth space. George McKay, Jr., and William D. Marshall form the exhibit committee.

Favor F. A. E. S. to Promote Engineering Congress

(Washington Correspondence)

A pronounced feeling exists in engineering circles in Washington that the proposed Engineering Congress to be held in connection with the Philadelphia Sesquicentennial in 1926 should be promoted in a national and international way, and that this can be done best by the Federated American Engineering Societies. Local promotion of the congress would be handicapped, it is believed, by the assumption that Philadelphia engineers naturally would be inclined by the incidental benefits to their city to represent such a gathering as certain to be a momentous occasion. If the arrangements were handled by the national machinery which the organizations in many branches of engineering have set up, it is believed a different impression will be created.

Wider Right of Way for Indiana Highways Is Sought

Owners of land contiguous to state roads, which the Indiana state highway commission wishes to widen, have been asked again to co-operate with the department by moving back property lines. Letters containing the request were sent out recently by Lawrence Lyons, director of the state highway commission. The commission, he said, wishes to have at least 50 ft. from fence to fence. Mr. Lyons said that many landowners appreciate the value of a modern highway adjacent to their land and are complying with requests previously made.

Engineering Societies

Calendar

Annual Meetings

NATIONAL FIRE PROTECTION ASSOCIATION, Boston, Mass.; Annual Meeting, Atlantic City, May 9-11.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, Philadelphia, May 15-19.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Annual Convention, Salt Lake City, Utah, June 5-7.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Annual Convention, Portsmouth, N. H., June 21-22.

The Ontario Good Roads Association held its annual convention at Toronto, March 1-3. The following officers were elected: President, W. H. Brown; vice-presidents, John Curry and George S. Henry; directors, F. A. Senecal, J. E. Jamieson, A. B. Rose, Peter Ray, F. H. Richardson, and W. H. Nugent.

The County Commissioners Association of Ohio held its annual meeting in Columbus last week, at which the following officers were elected: Allen Shale, Youngstown, president; J. J. Zmund, Cleveland, first vice-president; J. F. Booth, Akron, second vice-president; Richard Sinclair, Columbus, secretary; and John H. Hinchcliffe, Lisbon, treasurer.

The Seattle Branch, A. A. E., elected the following officers at its annual meeting: President, Major Garrison Babcock; first vice-president, J. W. A. Bollong; second vice-president, E. J. M. Gilman; third vice-president, H. J. M. Baker; fourth vice-president, W. J. Bennett; secretary-treasurer, W. B. Wolfendale.

The Denver Chapter, A.A.E., has elected the following officers for 1922: President, H. W. Gardner; vice-president, O. W. Childs; secretary, Joseph P. Arnold; treasurer, N. B. Hunt.

The Lincoln (Neb.) Chapter, A. A. E., has changed the date of the meeting at which Edwin S. Jarrett will speak from April 10 to April 11.

Personal Notes

L. P. LESSARD, formerly assistant sales manager for the T. L. Smith Co., Milwaukee, Wis., has been made district manager of the Chicago territory for the H. W. Roos Co. of Cincinnati, Ohio.

K. H. GEDNEY, formerly a member of the Gedney Construction Co., with offices in Kansas City, Mo., and Hastings and McCook, Neb., has organized the K. H. Gedney Co. in Hastings, Neb. The firm will specialize in building construction.

EDWARD A. EVANS, for nine years construction engineer and superintendent for the T. A. Gillespie Co., N. Y., has been made resident engineer on the Mountain Island Development for the Catawba Mfg. & Electric Power Co., N. C.

CLARENCE C. BROWN, formerly a captain in the 12th Engineers, has been appointed superintendent of construction for Scott & White and has full charge of the construction of a 58-mile branch railroad for the Santa Fe in western Kansas.

HAROLD SILCOX, Elizabeth, N. J., has been appointed general supervisor of bridges and structures in the construction division of the state highway commission.

CHARLES D. WATSON has become vice-president of the Watson Engineering Co., Cleveland, Ohio, succeeding H. R. HADLOW, retired.

R. L. HARDING has been made secretary of the Watson Engineering Co., Cleveland, Ohio, succeeding W. P. BROWN. Mr. Harding has been with the company as estimator and purchasing agent since his return from France in 1919.

HOWARD M. KING, Assistant Superintendent of Water-Works, Springfield, Mass., since 1910, has been appointed superintendent to succeed the late Alfred E. Martin. Mr. King was in the engineering division of these works from 1906 to 1910, on the construction of the Ludlow filters and of the additional supply from Little River.

W. A. VAN HOOK, cost engineer in the Bureau of Valuation of the Interstate Commerce Commission has resigned to become chief engineer of the Roberts-Pettijohn-Wood Corp., accountants and engineers, Chicago.

JOHN W. REID has been appointed city engineer of Detroit, Mich., and assumed his new duties on March 15 succeeding Clarence W. Hubbell who resigned on March 1 after several years in the employ of the city. Mr. Reid has been connected with the Detroit Department of Public Works for 22 years, having held positions from draftsman to chief engineer of the department of grade separations. He has been at the head of the grade separation department for several years.

JOSEPH L. BARTON, formerly assistant grade separation engineer, Detroit, Mich. has been made grade separation engineer succeeding John L. Reid, who has been appointed city engineer of Detroit.

CLOYD M. CHAPMAN of New York City has been appointed consulting engineer for the Freeport Sulphur Co., to design the sulphur reclamation plant to be built at Hoskins Mound, Texas, a property recently taken over by the Freeport company from the Texas Co. The Dwight P. Robinson Co., New York City, has the contract for the job.

W. H. WOODBURY, valuation engineer for the Duluth, Missabe & Northern Ry. and the Duluth & Iron Range R.R., has been elected president of the Minnesota Federation of Architectural and Engineering Societies.

J. S. HAZELTON, resident engineer for the Missouri State Highway Department in Webster County has been transferred to Newton County.

R. E. SPEAR, city engineer and assistant city manager of Ambridge, Pa., has resigned.

D. E. HARRINGTON, assistant city engineer, Madison, Wis., has resigned to enter the engineering and contracting business.

WILLIAM N. RYERSON has resigned as general manager of the Great Northern Power Co., Duluth, Minn., to enter the engineering field in New York City.

B. C. BRENNAN, city engineer of Kenosha, Wis., has resigned to enter the road-contracting business.

R. W. BARROW, has been chosen building inspector of Meriden, Conn., a position recently instituted.

SAMUEL E. DUFF, consulting engineer, has been elected president of the Memphis Steel Construction Co., Pittsburg, Pa., succeeding A. C. Hunt.

PROF. C. C. WILLIAMS has been named head of the civil engineering department, University of Illinois, succeeding Prof. I. O. Baker. Prof. Williams served formerly as professor of civil engineering at the University of Kansas. He was graduated from Illinois in 1907.

Business Notes

A. P. BLACKSTEAD, formerly chief engineer of the Camden Iron Works, Camden, N. J., and prior to that hydraulic engineer with the Henry R. Worthington Co., N. Y., has joined the engineering staff of the Dayton Dowd Co.

J. W. WUNSCH and C. V. TERKUILE have organized the firm of Wunsch & TerKuile, Brooklyn, N. Y., selling agents for manufacturers of materials-handling machinery and industrial and engineering equipment.

THE LAKEWOOD ENGINEERING CO., Cleveland, Ohio, announces that the CONTRACTOR'S TRADING CO., INC. will handle their building-construction equipment exclusively.

SANDVIK STEEL, INC., announces the consolidation of its general steel and steel-belt conveyor departments, with W. D. Thomas formerly manager of New York Export Sales—American Mill Co. as president and general manager.

THE BARBER ASPHALT PAVING CO. announces that the name of the firm will after March 31, 1922 be changed to the Barber Asphalt Co. The change involves no alteration in the organization or obligations of the company.

W. C. ALLEN, former manager of the Philadelphia branch, Black & Decker Co., has been made branch manager of the Chicago territory which takes in Wisconsin, Illinois, Missouri, Iowa, Minnesota and North Dakota.

OBITUARY

DANIEL L. NORRIS, construction engineer, who has been with the George A. Fuller Construction Co. since 1900 died at his home in Newark, N. J., March 23. He supervised the building of the Commodore, Biltmore and Plaza hotels, New York City, and subsequently went to Japan where he organized the oriental branch of the Fuller Co. and built some of the first modern office buildings and hotels in Tokio, Yokohama and Osaki.

HENRY P. NAWN, president of the Hugh Nawn Construction Co. Boston, Mass., died suddenly on March 29, at Gilboa, N. Y., where he was living while his firm was constructing a large dam to furnish additional water supply for New York City. He was born in Roxbury, Mass. in 1858 and entered his father's company soon after his graduation from the Roxbury schools, remaining with the firm until his death. Among the many contracts which his company executed were the construction of East Boston Tunnel, the Cambridge tunnel and stations, and other tunnel sections in Boston subways; the shipyards and docks at Hog Island, and the government proving grounds at Scituate.

MAJOR WILBUR FISK FOSTER, retired member of the firm of Foster & Creighton, died at his home in Nashville, Tenn., March 27. He was born in Massachusetts but went to Tennessee shortly before the Civil War, where his engineering training enabled him to render valuable services to the Confederate forces in laying out Fort Donelson and planning lines of defense. After the war Major Foster became city engineer of Nashville holding that position for a number of years. In 1884 he joined with R. T. Creighton in forming an engineering partnership which lasted until his retirement in 1909.

HARRY DEAN BUSH, 64 years old, general superintendent of the Carnegie Steel Co., Baltimore, Md., died on March 15 at his home in Baltimore. He was a native of Springfield, Mass., where he had been civil engineer at the bridge works of R. F. Hawkins. Later he was bridge engineer for the Northern Pacific R.R. and served for a year as assistant engineer in the office of George S. Morrison, N. Y. He then became superintendent for the Dominion Bridge Co., Ltd., Montreal, and came to Baltimore in 1903 as vice-president and manager for the Baltimore Bridge Co.

ALBERT W. MOORE, 64 years old, a resident of Indianapolis and widely known in Indiana for his work on state and county bridges, died recently at the home of his son at Fort Worth, Texas. Mr. Moore was director of the Lafayette Engineering Co. and had been in the contracting business for more than twenty years.

EQUIPMENT AND MATERIALS

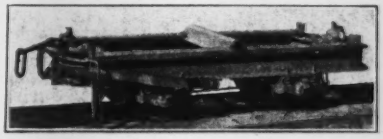
Oxy-Acetylene Torch Welds Cast-Iron Tar Kettle

The Oxweld shops in Chicago call attention to the welding of a 13-ton cast-iron tar kettle, 8 ft. in diameter by 8½ ft. in height, with a flange and wall thickness of 2¾ in. There were two ruptures, one break extending through the rim down into the body of the kettle for a distance of 18 in., and one, similar in character, about 26 in. long. The position and nature of the fractures were such that ordinary procedure in preparing the casting for welding could not be followed. The application of pre-heat presented an unusual problem, owing to the necessity for keeping the kettle in an upright position. To afford a base for a temporary furnace, empty carbide cans were piled up to a point just below the lowest zone requiring pre-heat, a thin covering of

light-gage steel sheets was provided, and the furnace of fire brick was set up on the sheeting. Had it been possible to employ customary preparation, it is estimated that there might have been a saving of approximately 40 per cent in time on the job as a whole. The smaller crack was welded in 8 hours, and the larger one in 11½ hours, the work being done by a crew of three. The net saving to the roofing company was $1,200. The job took three days.

Batch-Box Car of New Design

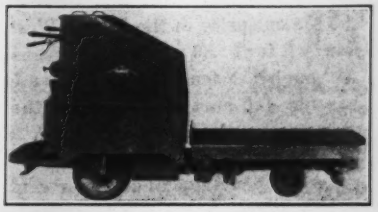
A new design of industrial railway car to carry two batch boxes of 33 cu.ft. capacity for concrete road construction, has been developed by the Koppel Industrial Car & Equipment Co., Koppel, Pa. Two particular features are the V-shaped separator between the seats for



the boxes, and a locking device which prevents the uncoupling of the cars without the removal of the coupler pin. A brake acting on all four wheels is operated by a treadle or foot lever. The car has a frame of 6-in. ship channels mounted on 14-in. cast-steel wheels.

Gasoline Lift Truck

A gasoline elevating-platform truck is being manufactured by the Clark Tructractor Co., Buchanan, Mich. The loading platform is 26 x 54 in. and will elevate its load of 4,000 lb. from a minimum of 11 in. to a maximum of 16 in. from the floor in eight seconds. Automatic stops provide for both up and down limits and elevation can be stopped by hand control lever at any



point. The lifting mechanism is operated by hydraulic pressure. Power for locomotion and for elevating the load is derived from a 15-h.p. 4-cylinder tractor engine. The engine is mounted at the rear in a closed compartment containing transmission, governor, vacuum tank, radiator, etc. The total weight of the truklift ready for service is 2,500 lb.; the over-all length is 107 in., the width 35½ in. and height 51 in.

Out-of-the-Ordinary Trade Publications

An instruction book for centrifugal pump users and operators has been prepared by the WORTHINGTON PUMP & MACHINERY CORPORATION, of New York. Erection and installation are described and curves are given of head, capacity, and efficiency. A new curve shows the maximum water temperature allowable for different suction lifts.

A notable pamphlet on wood car construction is published by the SOUTHERN PINE ASSOCIATION, New Orleans, La. Car development, storage and handling of car lumber, preservative treatment of car lumber and the properties of Southern yellow pine as car material are treated separately.

A manual for storing and seasoning cross-ties, both treated and untreated, has been published in a 16-page pamphlet by the CENTURY WOOD PRESERVING CO., Pittsburgh, Pa.

Business Side of Construction

Facts and Events that Affect Cost and Volume

March Contracts Largest in Two Years

Total of $191,782,262 Represents Double the Volume of Work Contracted for in March, 1921

The value of contracts let during the month of March, as reported in *Engineering News-Record*, attained the high total of $191,782,262, the largest figure that has been recorded since April, 1920. This figure is the actual money value of the contracts let. If converted into volume of construction it represents double that put under contract during the corresponding month of 1921 and also double the volume for a representative month of 1913. In actual money value March, 1922, exceeded March, 1921, and March, 1920, by approximately $78,000,000 and $44,000,000, respectively.

Three large contracts swelled the total considerably, these being the contract for the construction of the vehicular tunnels under the Hudson River in New York City, a $19,000,000 job; a $4,000,000 highway job in Maricopa County, Arizona; and a contract let by the federal government for the reconditioning of the steamship "Leviathan" which is estimated to cost in excess of $6,000,000.

However, the amount of street and road work put under contract during the past month—$46,369,788—has only been exceeded once since Jan. 1, 1920. The only figure exceeding that within the past two years was recorded in June, 1921—about $56,000,000.

Another class of building which has shown remarkable gains is miscellaneous buildings, which includes churches, educational buildings, bank and office buildings, lofts, apartment houses, etc. The total money involved in contracts for this class was $89,648,848, a figure which has not been approached, except in April of 1920, since Jan. 1, 1920. The figure for April, 1920, was then only $1,000,000 more than was recorded during the past month.

Another feature of the analysis of contracts let during the past month is the fact that industrial construction is coming to the front. The money involved in this class of construction is in excess of $16,000,000, a figure which has not been reached since December, 1920. There is a particular trend in this class of construction toward the building of large plants.

Of particular interest in analyzing street and road contract figures is the fact that an unusual amount of construction is being put under contract in the southern states. The southern states have crystallized their road-construction ideas within the past year and it is apparent that well-balanced programs are being put under contract early in the construction season.

The road-construction season promises the greatest activity that has yet been seen, for but few of the larger road-building states have really started letting their contracts. Volume this year will probably double 1921 contracts.

CONTRACTS LET IN MARCH OF 1920, 1921 AND 1922

Classification	March 1920	March 1921	March 1922
Waterworks	$2,213,262	$2,028,055	$1,199,221
Sewers	1,283,227	2,862,131	3,440,556
Bridges	2,238,661	1,443,060	1,151,391
Excavation, dredging	3,151,151	1,625,690	608,034
Streets, roads	26,220,967	25,880,109	46,369,788
Industrial	48,861,832	15,032,130	16,179,957
Buildings	47,541,078	56,520,231	89,648,848
Federal government	1,483,605	3,590,617	7,796,122
Miscellaneous	15,129,378	4,231,823	25,388,345
Total	$148,123,161	$113,213,846	$191,782,262

Engineering News-Record Construction Cost Index Number

April, 1922	**164.72**
March, 1922	162.04
April, 1921	213.07
Peak, June, 1920	273.80
1913	100.00

Engineering News-Record's Construction Cost Index Number is 2.68 points higher than last month, due to the recovery in steel and to a slight adjustment in the cement price in the Middle West. Structural shapes now sell for $1.50 per 100 lb., against $1.40 a month ago. Although the tendency of lumber is down, a new price has not yet been announced in the New York market. Average hourly rate for common labor remains at 43c. Thus, general construction cost is 23 per cent cheaper than one year ago and 40 per cent under the peak; it is 65 per cent above the 1913 level.

Engineering News-Record Construction Volume Index Number

Monthly	
March, 1922	**202**
February, 1922	100
March, 1921	88
1913	100
Yearly	
1921 (entire year)	88
1920 (entire year)	91
1913	100

Engineering News-Record's Construction Volume Index Number is 202 for the month of March, and 88 for the whole of 1921, as against 100 for 1913. This means that the actual volume of construction in 1921 (not the mere money value of the contracts let that year) is 12 per cent under the volume of construction for 1913. Our monthly volume number, 202 for March, 1922, is really the increment of construction, and indicates the rate at which contracts are being let as compared with 1913 awards. It must be borne in mind, however, that contracts awarded in March include the New York-New Jersey vehicular tunnels, about $19,000,000.

Car Surplus, Shortage and Freight Loading

Loading of revenue freight continues to show improvement, the total for week ending Mar. 11 being 829,128 cars, a gain of 25,873 cars over the preceding week. Contrasted with corresponding week in 1921 it is an increase of 128,688 cars, and with 1920 of 9,799 cars. In making comparisons with 1921, however, it should be stated that loading remained at a comparatively low figure during the first three months of that year due to the prevailing industrial depression, while in 1922 there has been a consistently upward trend.

Miscellaneous loading, which includes manufactured products, fertilizer, and construction and building materials, continues to show the largest improvement, showing an increase of 11,707 cars over the week ending Mar. 4, and 25,796 cars compared with the week ending Feb. 11.

Serviceable surplus cars totaled 216,661 for the week ending Mar. 15, a reduction of 7,185 cars from the previous week. Classified, there were 89,356 box cars and 79,803 coal cars; balance miscellaneous. Coal car surplus decreased 6,661 cars from the preceding week, while box cars increased 382. This is the first increase in box-car surplus since early January.

North Carolina Lets Road Work Costing $3,329,000

During February the North Carolina State Highway Commission placed under contract eight bridges and 212.14 miles of state highway at a total cost, (exclusive of the usual 10 per cent for engineering, contingencies, etc.) of $3,328,950. Of this 72.88 miles were of hard-surface type, i.e., plain concrete, reinforced concrete, or some type of asphalt on a 5-in. concrete base. The pavement widths were about equally divided between 16 ft. and 18 ft. These 72.88 miles will cost $2,160,380 to construct, the average cost per mile being $29,643, which includes all necessary grading, draining, clearing, small bridges and culverts, etc. There were 12.71 miles of penetration macadam, to cost $253,640 or $19,956 per mile.

The remaining 126.55 miles consisted of earth, sand-clay and gravel roads, and will cost $709,050 or $5,603 per mile. These roads will be hard-surfaced, probably in 1923. The eight bridge projects let will cost $205,880.

The above work comprised 34 projects for which 391 bids were received.

Arkansas County Plans Road Work

Road-construction plans for District 10, Pulaski County, Ark., have been completed by D. A. MacCrea, engineer for the board, and it is expected that work will begin in the late spring. The completion of the roads in this district will connect Little Rock with adjoining counties in six directions. Two other

Labor Rates and Conditions Throughout the Country

Despite certain local adjustments the average common labor rate for the entire country remains at 43c. per hr. In localities where common laborers are unorganized wages have reached a minimum of 15c. per hr. Residence building in Atlanta is particularly active at present; building permits aggregating $2,000,000 for the month of March, including a $900,000 apartment house. Pick-and-shovel men in Atlanta receive a flat rate of 20c. as against 20c.@25c. per hr. last month. In Dallas common laborers have been reduced to 25c., from 35c.@45c. per hr. St. Louis quotes a revised wage scale effective April 1, or 95c., for carpenters as against $1.25; 69c. for hod-carriers, reduced from 85c., and $1.06¼ for piledrivers and structural ironworkers as compared with $1.25 per hr. last month. San Francisco common labor rates have dropped from 47½c.@56c. to 47½c.@50c. per hr. Philadelphia reports present rates for common labor in building operations at 25c.@35c. per hr. for nonunion men; the union wage scale remains at 50c.@60c. per hr. for this grade of work. Cleveland wage rates are nominal pending settlement of strike difficulties.

The New Orleans wage schedule remains unchanged, but all classes of labor show a tendency to work for less than the standard rates. On small construction jobs carpenters will accept 70c. @75c. per hr. as against the regular scale of 88c. The big contractors maintain the union scale and the three crafts that the general contractors direct are carpenters, hoisting engineers and piledrivers; other crafts being handled by sub-contractors.

Minneapolis reports unemployment still prevalent and common laborers willing to work at considerably less than the established rate of 40c.@50c. per hr.; employment in such cases being short and intermittent. County Commissioners have fixed labor rates for the season as follows: common labor on county roads 50c., foreman 65c., teams 90c. per hr.

The lowest current pay scale for unorganized common labor is that obtaining in Birmingham. Hod-carriers receive 15c.@25c. as against 25c. per hr. and common laborers 15c. as compared with 15c.@25c. per hr., one month ago. Although the union scale for carpenters is 75c. the open shop range of pay is 50c.@60c. and down to 35c. per hr. The union rate for structural ironworkers is $1, but men are obtainable at 50c. per hr. under open shop conditions.

A somewhat slow but steady improvement, in general business conditions, is under way in New York. Although wage agreements between the Building Trades Employers' Association, the Building Trades Council and those representing the public have not as yet been entered into, building activities this year are somewhat better than normal. Gradual improvement in unemployment is also noticeable, particularly in the iron, steel and metals industries.

Labor rates in Syracuse, applying on the eight building trades recently under arbitration, have been established for the year 1922 as follows:

(Per Hour)	1921	1922
Carpenters	$1.00	$0.90
Lathers	1.00	0.85
Bricklayers	1.12½	1.05
Cement finishers	1.00	0.85
Hoisting engineers	1.00	0.85
Sheet metal workers	1.00	0.90
Steamfitters	1.12½	1.00
Marble workers	1.06¼	1.00

Current wage rates in Cincinnati expire May 1, 1922. Cincinnati is experiencing a shortage of hod-carriers and plasters with other trades plentiful.

Favorable weather conditions during the month just past, have visibly increased the number of employed in Denver and vicinity.

Detroit reports an increase in the number of employed in the building trades and a general revival of construction activities.

Labor plentiful, all classes.—Higher rates indicated by +, decreases by—

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$0.90	$0.70	$1.00	$0.30	.....	$1.00	—$0.20
Baltimore	1.25	.80	.87	.54	$0.74	1.00	.30
Birmingham	1.00	.75	.50@1.00	—.15@.25	.....	1.00	.15
Boston	.90	.75	.90	.60	.90	.90	.40
Cincinnati	1.25	.95	.95	.72½	.77¼	.95	.40
Chicago	1.10	1.00	1.10	.....	1.10	1.05	.72½
Cleveland	1.04	1.04	1.04	.60	.91	1.04	.57½
Dallas	1.00	1.00	1.00	.60	1.00	1.00	—.25
Denver	1.37½	1.00	1.00	.75@.81¼	1.00	1.00	.35@.40
Detroit	1.00	.80	.80@.90	.50@.60	1.00	.60@.80	.50
Kansas City	1.07½	1.00	1.00	.80	1.07½	1.07½	.70
Los Angeles	1.25	1.00	1.00	1.12½	.87½	1.00	.56@.62½
Minneapolis	1.00	.80	.80	.65	.....	.80	.40@.50
Montreal	.80	.60	.50	.30@.35	.50	.55	.25@.30
New Orleans	1.00	.88	.90	.40	.80	1.00	.30
New York	1.25	1.25	1.25	.87½	1.00	1.12½	.75
Pittsburgh	1.30	1.00	1.00	.80	1.00	1.00	.30@.60
St. Louis	1.25	—.95	1.25@1.37½	—.69	—1.06¼	—1.06¼	.30
San Francisco	1.12½	1.00	1.00	.75	1.00	1.12½	— 47½@.50
Seattle	1.00	.80	.90	.70	1.00	.80@.90	.50
Philadelphia	1.00	.90	.90	.75@90	1.00	.90	— 25@.35

county roads are already paved and one more partly finished, giving the capital city, in the center of the county and the state, a hub-like appearance on the map of paved highways, with nine paved roads to the county line as spokes.

Recommend Paving in Indianapolis

Recommendations for paving 46 streets and 122 alleys in Indianapolis at an estimated cost of more than $1,000,000 has been made to the board of public works in a report submitted by Martin J. Hyland, street commissioner. The cost would be met by the owners of property on the streets and alleys improved.

John L. Elliott, city engineer, estimated that the cost of improving the alleys in the list recommended would be about $732,000, while the cost of improving the forty-six streets would be about $460,000.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for in Construction News, pp. 151@166, are the following:

A high school at Hartford, Conn., $1,500,000.

A college addition at New York City, $1,000,000.

An apartment building at Philadelphia, Pa., $1,000,000.

An office building at Lafayette, Ind., $1,000,000.

Cost Distribution on Cleveland House Construction

This tabulation of labor distribution was computed by The Cleveland Housing Co. from costs of more than one hundred five- and six-room frame dwellings built during 1920 and 1921 in Cleveland. W. W. Dibrell, superintendent of construction for the company, calls attention to the fact that the masonry and carpentry items are noticeably higher in 1921 than in 1920, despite the wage cuts in the building crafts early in 1921. Mr. Dibrell says: "This is accounted for by the severe letting up of work early in 1921 and the fact that sub-contractors, keen for new work, bid on a very small margin, much lower than in 1920."

	1920			1921		
Trade	Total Per Cent	Per Cent Material	Per Cent Labor	Total Per Cent	Per Cent Material	Per Cent Labor
Excavating	2.8	....	2.8	2.3	....	2.3
Masonry	11.4	7.4	4.0	13.8	8.6	5.2
Carpentry	46.0	25.0	21.0	50.0	28.0	22.0
Roofing	1.4	.9	.5	1.4	.8	.6
Plaster	8.5	4.1	4.4	6.6	2.6	4.0
Painting	5.0	1.4	3.6	4.8	1.3	3.5
Plumbing	13.6	11.8	1.8	10.4	9.0	1.4
Electrical Work	2.8	2.3	.5	1.8	1.4	.4
Heating	3.4	2.5	.9	2.9	2.1	.8
Sheet Metal	.8	.5	.3	1.3	1.2	.1
Decorating	1.3	.3	1.0	1.2	1.0	.2
Miscel	3.0	2.7	.3	3.5	3.0	.5
Total	100.0	58.9	41.1	100.0	59.0	41.0

Rehearing of Hardwood Case Asked

Rehearing of the open-price association practice or a modification of the decree in the hardwood lumber case to permit of the collection and dissemination of production, sales and stock reports has been requested of the U. S. Supreme Court in a petition filed by the American Column and Lumber Co., the defendants in the recent suit in which the Court decided the practice was illegal because in violation of the anti-trust law. The lumber interests base their request on misinterpretation of certain phases of the case, and make general denial of the conclusions of the court that the purpose of the practice employed by the lumber interests was to curtail production or enhance prices.

Large Contracts Let

Among this week's announcements of contracts awarded in Construction News, pp. 151@166, are the following large projects: A 15-story hotel at Philadelphia, Pa., to J. R. Wiggins & Co., Otis Bldg., $3,000,000; a 17-story office building at Indianapolis, Ind., to the Bedford Stone & Constr. Co., Fletcher Savings & Trust Bldg., $1,225,000; a 21-story office building at Chicago, Ill., to Thompson-Starrett Co., 175 West Jackson Blvd., $2,000,000; a hotel at Berkeley, Cal., to Lindgren & Co., Monadnock Bldg., San Francisco, $1,000,000.

Monthly Prices of Construction Materials

Ups and Downs of the Market

Pig Iron—Slight advance in No. 2 foundry iron in several important centers. Market firmer in tone.

Railway Supplies—Maximum quotations on light rails down $1 per ton f.o.b. Pittsburgh; downward tendency in the Chicago market. Standard spikes, section angle bars and track bolts down at Pittsburgh and Birmingham mills.

Pipe—Cast-iron pipe, 4-in., down 20c. in New York and $1 in Birmingham. Drop of $2.50 in 4-in. and $3.50 per ton in 6-in. pipe in St. Louis. Market expected to stiffen unless pig iron prices decline. Slight drop in sewer pipe in Birmingham, Boston and Cincinnati; up in Philadelphia.

Road and Paving Materials—Road oils down ½c. per gal. in New York. Asphalt in packages down 50c. in Detroit, $1.50 in Chicago and $4 in Cincinnati; advance of $3.50 in Seattle and $1 per ton in Atlanta. Bulk asphalt down 55c. in Minneapolis, $1 in Detroit, $1.50 in Chicago and $4 in Cincinnati; up $5 per ton in St. Louis. Dressed paving stone, 4x8x4, $3.20 as against $3.25 in Chicago and $3.35 as compared with $3.25 per sq. yd. in St. Louis. Wood blocks down 21c. in Atlanta and 20c. per sq.yd. in Cincinnati.

Sand, Gravel and Crushed Stone—Gravel up 25c. in Dallas and down 12½c. per cu.yd. in Cincinnati. Sand down 20c. in St. Louis and 26c. per cu.yd. in Cincinnati. Crushed stone, 1½-in., quoted $1.65; ¾-in. at $1.75 in New York as against $1.75@$1.85 per cu.yd., one month ago. Crushed stone, ¾-in., down 20c. in Dallas and 33c. per cu.yd. in Cincinnati.

Lime—Common lump lime quoted in New York at $2.75@$3.18 as against $2.75 @$3.48 and lump finishing lime at $3.68 as compared with $3.68@$3.98 per bbl. (280-lb. net) one month ago. Hydrated finishing lime down $5 in Montreal; hydrated common down $1 in Boston and $3.50 per ton in Atlanta. Lump finishing lime down 5c. and common lump 10c. per bbl. (180-lb. net) in Boston.

Cement—Natural cement (Utica) $1.77 as against $1.93 per bbl. in Cincinnati; Rosendale cement at 80c. compared with 85c. per bag in Boston, last month. New York quotes portland cement at $2.30 as against $2 alongside dock and at $2.40 as compared with $2.30 per bbl. delivered, one month ago. Cement down 20c. in New Orleans and 15c. per bbl. in Dallas. Mill prices unchanged.

Structural Material — Structural shapes, plates and bars quoted at $1.50, f.o.b. Pittsburgh, quotations of $1.40@$1.45 per 100 lb. having almost disappeared from the market. Shapes and plates quoted in New York at $2.48 as against $2.63, and in St. Louis at $2.57½ as compared with $2.72½ per 100 lb. at warehouse. Reinforcing bars in New York $2.38 as against $2.53 per 100 lb. Structural rivets and wire nails decline in Pittsburgh and St. Louis. Expended metal lath down in Chicago; up in St. Louis. Steel sheet piling quoted at $1.75 as against $1.80 per 100 lb. f.o.b. Pittsburgh.

Brick and Hollow Tile—Common brick in New York $16@$16.50 as against $18 per 1,000, wholesale, alongside dock, one month ago. Down $1 in St. Louis and Birmingham and $2 in Denver and Cincinnati; up 15c in Dallas and 75c. in Atlanta. Hollow tile advances slightly in Cincinnati and Seattle; declines in Boston, New Orleans, Montreal and Birmingham.

Lumber—Drop of $1 per M. ft. b. m. in Douglas fir No. 1 common at San Francisco and $2 in long leaf yellow pine at Chicago; fir advances $1, spruce $2, pine $3 and hemlock $3.50 per M. ft. in Philadelphia. Lumber prices decline in Cincinnati, New Orleans, Atlanta, Montreal, Minneapolis, Dallas and Seattle.

Scrap—Advance of $1.50 per ton on iron and steel scrap in New York market. St. Louis prices advance $1@$1.50, excepting cast borings, which drop 25c. per net ton.

Manila Rope—Advance of 1c. in Atlanta; drop of 1½c. in New York, ½c. in Philadelphia and New Orleans and 1c. per lb. in St. Louis.

Explosives—Dynamite, 40 per cent gelatin, down 2c. in Los Angeles, 1c. in Birmingham and 1½c. per lb. in Philadelphia; 60 per cent. gelatin declines 3c. in Los Angeles, ½c. in Cincinnati, 3c. in Birmingham and 1¾c. per lb. in Philadelphia.

Linseed Oil—Prices again declining. New York quotes 82c.@83c. as against 87c. and Chicago 90c. as compared with 91c. per gal. (5 bbl. lots) one month ago.

Price advances since last month are indicated by **heavy type**; declines by *italics*

PIG IRON—Per Gross Ton—Quotations compiled by The Matthew Addy Co.:

	Current	One Year Ago
CINCINNATI		
No. 2 Southern (silicon 2.25 @ 2.75)	$20.50†	$30.50
Northern Basic	21.02†	27.52
Southern Ohio No. 2 (silicon 1.75 @ 2.25)	*21.64†*	30.50
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25 @ 2.75)	**28.16†**	36.51
BIRMINGHAM		
No. 2 Foundry (silicon 2.25 @ 2.75)	*15.78†*	26.50
PHILADELPHIA		
Eastern Pa., No. 2X, (2.25@2.75 sil.)	*21.34†*	27.00*
Virginia No. 2 (silicon 2.25 @ 2.75)	27.74†	28.00*
Basic	**21.00†**	26.25†
Grey Forge	*20.50†*	27.00*
CHICAGO		
No. 2 Foundry Local (silicon 1.75 @ 2.25)	20.00†	25@27
No. 2 Foundry Southern (silicon 2.25 @ 2.75)	*21.67†*	32.92
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley (silicon 1.75 @ 2.25)	*19.00†*	26.96
Basic	*18.00†*	26.86
Bessemer	*19.50†*	27.00

*F.o.b. furnace. † Delivered.

RAILWAY SUPPLIES

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots, 5c. per 100 lb. is charged extra:

	Pittsburgh			
	Current	One Year Ago	Birmingham	Chicago
Standard bessemer rails	$40.00	$45.00	.....	$40.00
Standard openhearth rails	40.00	47.00	$40.00	40.00
Light rails, 8 to 10 lb.	28.00@*29.00*	2.20@2.55*	1.60*	1.65*
Light rails, 12 to 14 lb.	28.00@*29.00*	2.15@2.50*	1.60*	1.65*
Light rails, 25 to 45 lb.	28.00@*29.00*	2.10@2.45*	1.60*	1.65*
Rerolled Rails	1.45@1.50*	.....	.....	.....

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8½ Ft.	7 In. x 9 In. by 8½ Ft.
Chicago, White Oak	$1.35	$1.50
Chicago, Hardwood and Red Oak	1.20	1.30
Chicago....Empty Cell Creosoting (add'l)	.45	.50
San Francisco..... Green Douglas Fir	.85	1.10
San Francisco, Empty Cell Creosoted. Douglas Fir	1.86	2.30
St. Louis, White Oak*	1.10	1.30
St. Louis, Red Oak*	97	1.17

*Standard specifications 38c. per tie additional. Zinc chloride process 27c. per tie additional.

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh					
	Current	One Year Ago	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, ½-in. and larger	$2.00@*2.35*	$3.30@3.65	$2.55	$3.47½	$4.25	*$3.10*
Track bolts	*2.90@3.00*	4.60@5.50	3.65	4.47½	5.25	*4.05*
Standard section angle bars	*1.40@1.50*	2.45@2.75	2.40	3.25	4.00	*3.25*

PIPE

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the latest Pittsburgh basing card:

BUTT WELD

Inches	Steel Black	Steel Galv.	Inches	Iron Black	Iron Galv.
to 3	71	58½	¼ to 1¼	44½	29½

LAP WELD

2	64	51½	2	39½	25½
2½ to 6	68	55½	2½ to 6	42½	29½
7 to 8	65	51½	7 to 12	40½	27½
9 to 12	64	50½			

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1¼	69	57½	¼ to 1¼	44½	30½
2 to 3	70	58½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	62	50½	2	40½	27½
2½ to 4	66	54½	2½ to 4	43½	31½
4½ to 6	65	53½	4½ to 6	42½	30½
7 to 8	61	47½	7 to 8	35½	23½
9 to 12	55	41½	9 to 12	30½	18½

STEEL—From warehouses at the places named the following discounts hold for steel pipe:

	Black		
	New York	Chicago	St. Louis
1 to 3 in. butt welded	66%	62½%	59%
2½ to 6 in. lap welded	61%	59½%	56%

	Galvanized		
	New York	Chicago	St. Louis
1 to 3 in. butt welded	53%	48½%	45%
2½ to 6 in. lap welded	47%	45½%	42%

Malleable fittings, Class B and C, from New York stock sell at list less 10%. Cast iron, standard sizes, *32-5%* off.

*CAST-IRON PIPE—The following are prices per net ton for carload lots:

	New York					
	Current	One Year Ago	Birmingham	Chicago	St. Louis	San Francisco
4 in.	*$50.30*	$73.30	*$36.00*	47.10	*$43.70*	$52.00
6 in. and over	47.30	63.30	*32.50*@33.00	43.10	*39.70*	48.00

Gas pipe and Class "A," $4 per ton extra; 16-ft. lengths, $1 per ton.

CLAY DRAIN TILE—The following prices are per 1000 lin.ft.:

	New York					
Size, In.	Current	One Year Ago	St. Louis	Chicago	San Francisco	Dallas
3	$40.00	$50.00	.....	$50.00	.....	$55.00
4	50.00	60.00	*$80.00*	60.00	$90.00	65.00
5	80.00	90.00	.....	80.00	115.00	84.00
6	100.00	115.00	140.00	100.00	150.00	110.00
8	150.00	185.00	200.00	150.00	250.00	181.00

SEWER PIPE—The following prices are in cents per foot for carload lots f.o.b.:

Size, In	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Dallas
3	$0.14	$0.087	.....	$0.10	$0.12	$0.12	.....
4	.14	.087	*$0.08*	.10	.12	.15	$0.18
5	.21	.1305	.10	.14	.18	.18	.165
6	.21	.1305	*.12*	.14	.18	.21	.25
8	.35	.203	*.20*	.255	.28	.30	.35
10	.52	.3045	.26	.315	.42	.42	.....
12	.67	.3915	*.34*	.405	.54	.54	.80
15	1.15	.522	*.50*	.285	.72	.90	.....
18	1.55	.725	*.68*	.765	1.00	1.32	.....
20	1.98	.87	*.90*	.....	1.20	.....	.....
22	2.64	1.16	1.10	.....	1.60	.....	.....
24	2.97	1.305	*1.30*	1.35	1.80	2.16	2.40
27	4.50	1.885	.....	2.25	3.75	3.00	.....
30	5.00	2.088	.....	2.70	4.75	3.60	.....
33	6.55	2.61	.....	3.35	5.50	.....	.....
36	7.50	2.9725	.....	3.65	6.00	.....	.....

	3	5	8	12	24	36
Boston	*$0.105*	*$0.1575*	*$0.245*	*$0.4725*	*$1.575*	*$4.408*
Minneapolis	.....	.....	.40	.77	2.55	5.66
Denver	.135*	.18*	.27	.47	1.70	.....
Seattle	.145	.....	.36	.72	2.59	.....
Los Angeles	.11*	.165*	.275	.495	1.65	.....
New Orleans	.....	.108	.27	.459	1.755	.....
Cincinnati	*.096*	*.144*	*.22½*	*.43*	*1.44*	4.382
Atlanta	.078*	*.117**	1.95	.3315	1.2675	.....
Montreal, *delivered*	.30*	.45*	70*	1.35	4.50	6.50
Detroit	.105	.1575	.245	.4725	2.115	5.4325
Baltimore	.1225	.2275	.35	.6870	2.29	5.23
Kansas City, Mo	.15*	.21*	.335	.60	2.41	4.74
Philadelphia	.105	.1575	.245	.4725	1.575	3.5875

*4-in., 6-in., 9-in., respectively.

ROAD AND PAVING MATERIALS

ROAD OILS—Following are prices per gallon in tank cars 8,000 gal. minimum f.o.b. place named:

		Current	One Year Ago
New York, 45% asphalt	(at terminal)	$0.05	$0.07
New York, 65% asphalt	(at terminal)	*.045*	.07
New York, binder	(at terminal)	*.055*	.07½
New York, flux	(at terminal)	*.05*	.07
New York, liquid asphalt	(atterminal)	.06	.08½
St. Louis, 40-60% asphalt (*f.o.b.*) *Tulsa, Okla.*		.03½	.11
Chicago, 40-50% asphalt		.05	.06
Chicago, 60-70% asphalt		.05½	.06½
Dallas, 40-50% asphalt		.10	.10
Dallas, 60-70% asphalt		.13	.13
Dallas, 75-90% asphalt		.15	.15
San Francisco, binder, per ton		13.00†	15.00

* Freight $21.75 per ton to Whiting, Ind.
† F.o.b. Oleum, Cal. Freight to San Francisco, 80c. per ton.

ASPHALT—Price per ton in packages (350-lb. bbl. or 425-lb. drums) and in bulk in carload lots:

	Package	Bulk
New York (Bayonne, N. J.)	$25.00	$15.00
Boston	No quotations	
Chicago	*24.35*	*18.00*
San Francisco, *f.o.b. refinery*, Oleum, Cal.	19.50*	13.50*
Dallas	35.00	27.00
Seattle	28.90	.....
Denver	40.00	.....
Minneapolis	.....	*19.95*
St. Louis	30.00	30.00
Baltimore	25.00	20.00
Los Angeles, *at factory*	22.50	15.00
Montreal	28.00	21.00
Atlanta	28.00	.....
Detroit (petroleum asphalt)	*25.00*	*19.00*
Cincinnati	*32.00*	*28.00*
Maurer, N. J. (natural asphalt)	36.00	33.00
Maurer, N. J. (artificial asphalt)	22.00	20.00
Philadelphia	24.00	17.50
Kansas City	28.83	22.83

*Freight to San Francisco, 80c. per ton.

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums. Rebates of about $1 per bbl., no rebate for drums.

PAVING STONE—

New York	5-in. granite, 28@29 blocks per sq.yd.	$130.00	per M
Chicago	About 4x8x4 dressed	*3.20*	sq.yd.
	About 4x8x4 common	3.00	sq.yd.
San Francisco	Basalt block 4x7x8	70.00	per M
Boston	5-in. granite	125.00	per M
Atlanta	Granite	2.00	sq.yd.
Detroit	Granite, 26½ blocks per sq.yd.	3.05	sq.yd.
Baltimore	Granite	2.00	sq.yd.
Montreal	Granite	125.00	per M
New Orleans	Granite, 4 x 8 x 4	3.25	sq.yd.
Cincinnati	Granite	3.84@4	sq.yd.
St. Louis	4x8x4 dressed	3.35	sq.yd.
	4x8x4 common	3.00	sq.yd.
Kansas City	No. Granite	3.95	sq.yd.
Philadelphia	Granite	125.00	per M.

FLAGGING—

New York	Bronx	$0.25	sq.ft.
	Manhattan, 4 ft.	.26	sq.ft.
	Queens, 5 ft.	.26	sq.ft.
	6x20-in. cross-walk	1.00	lin.ft.
Chicago	18 in. wide	.99	lin.ft.

CURBING—Bluestone per lineal foot, in New York, costs 77c. for 5x16 in., 88c. for 5x18 in.; in cargo lots.

WOOD BLOCK PAVING—

	Size of Block	Treatment	Per Sq.Yd.
New York (*delivered*)	3	16	$2.04
New York (*delivered*)	3½	16	2.17
New York (*delivered*)	4	16	2.36
Boston	3	16	2.17
Chicago	4	16	3.00@3.25
Chicago	3½	16	2.50@2.75
St. Louis	3½	16	2.50
St. Louis	4	16	3.00
Seattle	4	16	Off market
Minneapolis	3½	16	2.13
Atlanta	3½	16	*2.09*
New Orleans	3	16	1.60
New Orleans	3½	16	1.80
New Orleans	4	16	2.00
Dallas	4	18	3.90
Baltimore	3½	16	3.44
Montreal	4	16	4.50
Detroit	3	16	2.84
Detroit	4	16	3.00
Cincinnati	4	16	*2.10*
Kansas City	4	16	2.15
Philadelphia	3½	16	3.50

CONSTRUCTION MATERIALS

SAND AND GRAVEL—Price for cargo or carload lots to contractor is as follows, per cu.yd.:

	Gravel 1½ In. Current	Gravel 1½ In. One Year Ago	Gravel ¾ In. Current	Gravel ¾ In. One Year Ago	Sand Current	Sand One Year Ago
New York	$1.75	$2.50	$1.75	$2.50	$1.00	$1.25
Denver	2.50	2.00	2.50	1.80	1.10	1.60
Chicago	2.00	2.75	2.00	2.75	2.00	2.75
St. Louis, *per ton*	1.25	1.65	1.30	1.70	*1.10*	1.70
Seattle	1.50	1.50	1.50	1.50	1.50	1.50
Dallas	2.25	1.75	2.25	1.75	2.25	1.75
Minneapolis	1.50	2.00	1.50	.....	1.00	1.00
Cincinnati	*1.87½*	2.00	*1.87½*	2.00	*1.45*	1.30
San Francisco	2.25	2.50	2.25	2.50	1.50	1.65
Boston	2.40	2.65	2.40	2.65	1.65	2.00
New Orleans	2.08½	2.85	2.08½	.....	1.35	1.65
Los Angeles, per ton	1.50†	1.55	1.50†	1.45	1.35†	1.00
Atlanta, per ton	1.85	2.80	1.85	1.15	1.15	1.50
Detroit	2.00	1.85*	2.00	1.85*	2.00	2.50
Baltimore, per ton	1.40	1.40‡	1.60	1.60‡	2.00	.70
Montreal, per ton	1.25	1.50‡	1.50	1.75	1.25	1.40
Birmingham, per ton (Crushed slag used instead of gravel)					1.25	1.25‡
Philadelphia	1.50	.....	1.55	.....	1.60	.....
Kansas City	2.00	3.25	2.00	3.75	1.20	1.25

* Fine white sand: Pacific, $4 per ton; Ottawa, $4.50

† Freight from quarry to Los Angeles is 85c. per ton, and is included in above price.

‡ Per cu. yd.

CRUSHED STONE—Price for cargo or carload lots f.o.b. city, unless stated otherwise, is as follows, per cu.yd.:

	1½ In. Current	1½ In. One Year Ago	¾ In. Current	¾ In. One Year Ago
New York	*$1.65*	$1.90@2.00	$1.75	$2.15
Chicago	1.60	2.75	1.60	2.75
St. Louis *delivered*	1.65	1.85	1.65	1.85
Dallas, *delivered*	*2.73*	2.10	*2.73*	2.10
San Francisco	2.25	2.50	2.25	2.50
Boston, *delivered*	3.00*	3.00* del.	3.00*	3.00* del.
Minneapolis, *at plant*	2.00	2.00	2.25	2.25
Kansas City, *at plant*	2.10	2.35	2.10	2.35
Denver	3.50	.....	3.50	.....
Seattle *delivered*	3.00	3.50 de.	3.00	3.50 del.
Atlanta	1.90*	2.50*	1.90*	.....
Cincinnati *delivered*	*1.75*	2.30	*1.75*	2.15
Los Angeles	1.75*	1.75*	1.85*	1.80*
Detroit	1.90*	2.00	1.90*	2.00*
Baltimore	1.75*	1.75*	1.65*	1.75*
Montreal	2.00*	2.00*	2.10*	2.10*
Birmingham *delivered*	3.20	.....	3.10	.....
Phildelphia	1.70*	.....	1.55*	.....

*Per ton.

CRUSHED SLAG—Price of crushed slag in carload lots, per net ton, at plants:

	1½-In.	¾-In.	Roofing	Sand
Youngstown District	$1.30	$1.30	$2.00	$1.30
Steubenville District	1.40	1.40	2.00	1.40
Ironton District	1.40	1.40	2.00	1.40
Emporium, Pa.	1.25	1.25	.....	1.25
Easton, Catasaqua, Pa.	1.00	1.00	2.00	0.90
Birmingham, Ala.	1.05	1.15	2.05	0.80
Buffalo, N. Y., and Erie, Pa.	1.25	1.25	2.25	1.25
Cleveland, Ohio	1.20	1.20	.....	1.00
Eastern Pennsylvania and Northern New Jersey	1.20	1.20	2.00	1.20
Western Pennsylvania	1.25	1.25	2.00	1.25

LIME—Warehouse prices:

	Hydrated, per Ton Finishing	Hydrated, per Ton Common	Lump, per Barrel Finishing	Lump, per Barrel Common
New York	$15.70@$16.80	$12.50	$3.68	*$2.75@$3.18**
Chicago	18.00	.....	.....	1.40†
St. Louis	23.20	20.00	2.50†	2.50†
Boston	23.00	*19.50*	*3.30†*	*3.00†*
Dallas	25.00	.....	.....	2.50†
Cincinnati	15.10	12.50	10.75	12.50‡
San Francisco	22.00	18.00	.....	1.75†
Minneapolis	29.00	22.00 (white)	1.70†	1.40†
Denver	24.00	.....	.....	2.70†
Detroit	18.00	16.00	.....	17.00‡
Seattle	27.00	.....	3.00†	2.75†
Los Angeles	30.00	30.00	.....	3.00*
Baltimore	15.00	13.00	.....	12.00‡
Montreal	*21.00*	21.00	15.00‡	11.00‡
Atlanta	18.00	*12.50*	2.00†	*1.25†*
New Orleans	.....	17.25	1.12†	.....
Philadelphia	13.00	11.50	10.50‡	9.50‡

*280-lb. bbl. (net). †Per 180-lb. bbl. (net). ‡Per ton—Refund of 10c. per bbl.
Minneapolis quotes brown lime; Kelly Is. white is $1.70, Sheboygan $1.55.
Seattle quotes hydrated finishing lime in cloth sacks; paper sacks, $24.00 per ton.

NATURAL CEMENT—Price to dealers per bbl. for 500 bbl. or over, f.o.b., exclusive of bags:

	Current	One Year Ago
Minneapolis (Rosendale)	$2.80	$2.80
Kansas City (Ft. Scott)	1.60	1.60
Atlanta (Magnolia)	11.00 ton	11.00
Cincinnati (Utica)	*1.77*	2.75
Boston (Rosendale) per bag	*.80*	2.35

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots f.o.b. points listed *without bags*. Cash discount not deducted.

	Current	One Month Ago	One Year Ago
New York*	$2.40	$2.30	$3.10
New York, alongside dock to dealers	2.30	2.00	2.40
Jersey City	2.12	2.12	2.64*
Boston	2.50	2.50	2.87
Chicago	1.97	1.94	2.17
Pittsburgh	2.02	2.02	2.17
Cleveland	2.26	2.26	2.43
Detroit	2.17	2.17	2.51
Indianapolis	2.21	2.21	2.31
Toledo	2.20	2.20	2.51
Milwaukee	2.18	2.13	2.39
Duluth	1.95	1.95	2.10
Peoria	2.08	1.98	2.43
Cedar Rapids	2.21	2.11	2.51
Davenport	2.16	2.06	2.47
St. Louis	2.20	2.20	3.40
San Francisco	2.73	2.73	3.09
New Orleans	*3.00*	3.20	3.36
Minneapolis	2.24	2.24	2.41
Denver	2.90	2.90	3.10
Seattle	2.94	2.94	3.10
Dallas	*2.85*	2.40	2.85
Atlanta	2.39	2.39	3.00
Cincinnati	2.35	2.32	2.57
Los Angeles	3.30	3.30	3.21
Baltimore*	2.50	2.50	3.58*
Birmingham	2.27	2.27	.....
Kansas City	2.40	2.40	2.76
Montreal	2.40	2.40*	3.44
Philadelphia	2.21	2.21	.....
St. Paul	2.24	2.24	2.41

NOTE—Bags 10c. each, 40c. per bbl.;

Current mill-prices per barrel in carload lots, without bags; to contractors:

Buffington, Ind.	$1.70	Mason City, Ia.	$1.95
Universal, Pa.	1.75	Hudson, N. Y.	1.90
Steelton, Minn.	1.75	Leeds, Ala.	1.95
Fordwick, Va.	1.95	Hannibal, Mo.	1.85
Mitchell, Ind.	1.95	Lehigh Valley District	1.70
LaSalle, Ill.	1.70	Kingsport, Tenn.	1.95
Iola, Kan.	1.95	Richard City, Tenn.	1.95

*Delivered by truck at site of work.

TRIANGLE MESH—Price per 100 sq.ft. in carload lots:

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds per 100 sq.ft.	Pittsburgh, Mill	Warehouse: New York	Chicago	Dallas	San Francisco
032	22	$0.68	$1.08	$0.76	$1.15	$1.15
049	28	.87	1.33	.98	1.46	1.48
068	35	1.05	1.58	1.18	1.80	1.80
093	45	1.35	1.99	1.52	2.30	2.32
126	57	1.65	2.43	1.87	2.86	2.87
153	68	1.97	2.88	2.23	3.40	.....
180	78	2.26	3.28	2.56	3.93	.....
245	103	2.99	4.29	3.38	5.15	.....
287	119	3.45	4.95	3.90	5.96	6.01
336	138	4.00	5.72	4.52	7.32	.....
395	160	4.64	6.61	5.20	8.00	.....
			PAVING			
036P	17	$0.52	$0.83	$0.58	$0.88	.....
053P	24	.73	1.14	.82	1.24	.....
072P	31	.91	1.40	1.00	1.57	.....
097P	40	1.18	1.77	1.29	2.02	.....
049R	24	.73	1.14	.67	1.24	.....
067R	31	.91	1.40	1.00	1.57	.....
084R	40	1.18	1.77	1.29	2.02	.....

In rolls 16-, 20-, 24-, 28-, 32-, 36-, 40-, 44-, 48-, 52-, and 56-in. wide and in 150-, 200- and 300-ft. lengths. Galvanized is about 15% higher. Size of roll carried in New York warehouses, 48 in wide x 150 ft. long, or 600 sq. ft.

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted are as follows:

Gage	Weight	*New York	Chicago	St. Louis	San Francisco	Dallas
27BB	2.3	$21.20	*$21.39*	$21.25	$23.87	$25.50
26BB	2.5	22.65	*22.93*	22.75	26.21	27.56
25BB	3.0	25.30	.....	27.10	.....	30.71
24BB	3.4	27.10	*27.33*	29.25	27.90	33.16
22PO	4.33	31.75	*29.56*	31.75	.....	35.10

* Price to contractors at warehouse or delivered on job in Manhattan, Bronx or Brooklyn.

BARS, CONCRETE REINFORCING—Current quotations per 100 lb.:

ROLLED FROM BILLETS

Inches	Pittsburgh Mill	Birmingham Mill	Warehouse, Uncut: New York	Chicago	St. Louis	Dallas	San Francisco
½ and larger	$1.50	$1.60	*$2.38*	*$2.28*	$2.50	$3.50	$2.75
⅝ and larger	1.55	1.65	*2.43*	*2.33*	2.55	3.55	2.80
¾ and larger	1.60	1.65	*2.48*	*2.38*	2.60	3.60	2.85
⅞ and larger	1.75	1.70	*2.53*	*2.53*	2.85	3.75	3.00
1 and larger	2.00	1.70	*2.58*	*2.78*	3.00	4.00	3.25

Includes 15c charge for cutting to lengths of 2 ft. and over. Twisted bars cut to length take extra of 27½c. per 100 lb.

ROLLED FROM RAILS

	Chicago	St. Louis	Dallas		Chicago	St. Louis	Dallas
½ and larger	*$1.50*	$2.25	$3.25	½	*$1.75*	$2.60	$3.50
⅝ in.	*1.55*	*2.30*	3.30	¼	*2.00*	2.75	3.75
¾	*1.60*	2.35	3.35	.....	.....	.....	.....

BRICK—Contractors price per 1,000 in cargo or carload lots is as follows:

	Common: Current	One Month Ago	One Year Ago	Paving Block: 3-inch*	4-inch*
New York (del.)	*$19.40@19.90*	$21.40	$21.70	$44.50	$49.50
New York (at dock)	*16@16.50*	18.00	.....	.....	.....
Chicago	11.00	11.00	15.00	34.00	42.00
St. Louis, salmon	*16.00*	17.00	15.00	37.50	37.50
Denver, salmon	*12.00*	14.00	14.00	.....	.....
Dallas	11.15	11.00	18.50	no market	
San Francisco	*15.00*	15.50	18.00	.....	44.38
Los Angeles	15.00	15.00	15.50	(not used)	
Boston (del.)	16.00	16.00	25.00	46.50	52.60
Minneapolis (del.)	15.00	15.00	18@20	.....	43.00
Kansas City	14.50	14.50	22.00	.....	.....
Seattle	14.00	14.00	19.00	*44.00*	.....
Cincinnati	*15.00*	17.00	21.00	41.00	36.50
Montreal (del.)	16.00	16.00	18.00	.....	*68.00*
Detroit (del.)	16.50	16.50	18.00	*36.50*	*39.50*
Baltimore (del.)	20.00	20.00	20@25	36.00‡	.....
Atlanta	9.00	8.25	12.00	34.00	.....
New Orleans	12.50	12.50	21.50	.....	.....
Birmingham	*9.50*	10.50	.....	.....	.....
Philadelphia	16.00	16.00	.....	.....	42.00

* For paving blocks 3½x8½x3 and 3½x8½x4 respectively. ‡ Vitrified, f.o.b. plant, Baltimore.

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York: Current on Trucks*	One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco	Perth Amboy N. J., Factory*
4x12x12	$0.11120	$0.1895	$0.0821	$0.095	$0.08	$0.108	.....
6x12x12	.16670	.2526	.0950	.....	.11	.156	.....
8x12x12	.20840	.....	.1295	.175	.145	.244	$0.17890
10x12x12	.....	.....	.1584	.....	.19	.....	.21050
12x12x12	.....	.....	.1811	.255	.22	.....	.27370

* 5 per. off for cash.

	4x12x12	8x12x12	12x12x12
Boston	*$0.094*	*$0.177*	*$0.244*
Minneapolis (f.o.b. cars)	.0672	.105	.168
Minneapolis (delivered)	.0752	.1175	.188
Cincinnati	.0670	.1263	.175
Kansas City	.085	.167	.270
Denver	.08	.145	.21
Seattle	.12	.25	.30
Los Angeles factory	.095	.176	.22
New Orleans	*.12*	*.23*	*.36*
Detroit (delivered)	.070	.135	.225
Montreal	*.095*	*.18*	*.30*
Baltimore	.14	.25	.39
Atlanta	.06525	.1015	.....
Dallas	*.115*	.....	.....
Birmingham	*.09*	*.16*	.....

San Francisco, Philadelphia and New York quote on hollow partition tile.

STRUCTURAL MATERIAL—Following are base prices f. o. b. mill, Pittsburgh and Birmingham together with quotations per 100 lb. from warehouses at places named:

	Pittsburgh, Mill	Birmingham Mill	Warehouse: New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in.	1.50	$1.65	*$2.48*	$4.00	*$2.57½*	*$2.38*	$3.10
Channel, 3 to 15 in.	1.50	1.65	*2.48*	4.00	*2.57½*	*2.38*	3.10
Angles, 3 to 6 in., ¼ in. thick	1.50	1.65	*2.48*	4.00	*2.57½*	*2.38*	3.10
Tees, 3 in. and larger	1.50	1.65	*2.48*	4.00	*2.57½*	*2.38*	3.10
Plates	1.50	1.65	*2.48*	4.00	*2.57½*	*2.38*	3.10

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Pittsburgh, Mill	Warehouse: New York	New York: One Yr. Ago	Chicago	St. Louis	San Francisco	Dallas
½ in. and larger	*$2.00@2.10*	*$3.35*	$5.08	*$3.00*	*$3.09½*	$4.50	$5.50

CONE HEAD BOILER

½ in. and larger	*2.10@2.20*	*3.45*	5.18	*3.10*	*3.10½*	4.60	5.65
⅝ and ¹¹⁄₁₆	*2.25@2.35*	*3.61*	5.33	*3.25*	*3.26½*	4.75	5.80
¾ and ⅞	*2.50@2.60*	*3.85*	5.58	*3.50*	*3.50½*	*5.00*	6.05

Lengths shorter than 1 in. take an extra of 50c. Lengths between 1 in. and 2 in. take an extra of 25c.

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh, Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire	*$2.40*	*$3.15*	$3.90	$5.00	*$3.47*	$4.95
Cut	2.25	5.80	5.90	7.75	.....	5.00

PREPARED ROOFINGS—Standard grade rubbered surface, complete with nails and cement, costs per square as follows:

	New York: 1-Ply l.c.l.	2-Ply l.c.l.	3-Ply l.c.l.	Philadelphia: 1-Ply l.c.l.	2-Ply l.c.l.	3-Ply l.c.l.
No. 1 grade	$2.02	$2.38	$2.80	$1.92	$2.28	$2.70
No. 2 grade	1.77	2.08	2.45	1.67	1.98	2.35

Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs $1.95 per roll in carload lots and $2.20 for smaller quantities f.o.b. Philadelphia.

Shingles, red and green slate finish, cost $5.50 per square in carloads; $5.75 in smaller quantities, in Philadelphia.

ROOFING MATERIALS—Prices f.o.b. New York:

Tar felt (14 lb. per square of 100 sq.ft.) per roll of 432 sq.ft.	$2.00
Tar pitch (in 400-lb. bbl.), per 100 lb.	*1.60*
Asphalt roofing (in barrels), per ton, f.o.b. plant*	47.50
Asphalt felt (light), per ton, f.o.b. plant*	67.00
Asphalt felt (heavy), per ton, f.o.b. plant*	68.50

* Delivered in Metropolitan Dist., $3.00 additional.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh, Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10	$2.25	$3.47½	$3.38	$3.95	$3.28
No. 12	2.30	3.52½	3.43	4.00	3.33
No. 14	2.35	3.57½	3.48	4.05	3.38
No. 16	2.55	3.67½	3.58	4.15	3.48
Black					
*Nos. 18 and 20	2.85	3.55	3.95	5.25	3.80
*Nos. 22 and 24	2.90	3.70	4.00	5.30	3.85
*No. 26	2.95	3.85	4.05	5.35	3.90
*No. 28	3.00	4.15	4.15	5.45	4.00
Galvanized					
No. 10	3.00	4.15	4.15	...	*3.75@3.90*
No. 12	3.10	4.25	4.25	5.40	*3.85@4.00*
No. 14	3.10	4.25	4.25	5.40	*3.85@4.00*
Nos. 17 to 21	3.40	4.45	4.55	5.70	*4.15@4.30*
Nos. 22 and 24	3.55	4.70	4.70	5.85	*4.30@4.45*
*Nos. 25 and 26	3.70	4.85	4.85	6.00	*4.45@4.60*
*No. 28	4.00	5.15	5.15	6.30	*4.75@4.90*

*For painted corrugated sheets add 30c. per 1,000 lb. for 5 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

LINSEED OIL—These prices are per gallon:

	New York: Current	One Year Ago	Chicago: Current	One Year Ago
Raw in barrel (5 bbl. lots)	*$0.88@0.83*	$0.73	*$0.90*	$0.82

WHITE AND RED LEAD—Base price in cents per pound:

	Red				White	
	Current		1 Year Ago		Current	Yr. Ago
	Dry	In Oil	Dry	In Oil	Dry or In Oil	Dry or In Oil
100-lb. keg	12.25	13.75	13.00	14.50	12.25	13.00
25 and 50-lb. kegs	12.50	14.00	13.25	14.75	12.50	13.25
12½-lb. keg	12.75	14.25	13.50	15.00	12.75	13.50
5-lb. cans	15.25	16.75	16.00	17.50	15.25	16.00
1-lb. cans	17.25	18.75	18.00	19.50	17.25	18.00

LUMBER

Prices wholesale to dealers in carload lots, f.o.b.

San Francisco—Prices of rough Douglas fir No. 1 common, in more than carload lots. To contractors, $2 per M ft. additional.

Lumber Prices to Contractors in Yards at San Francisco

	6–8 and 12 Ft.	10–16–18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$26.00	$26.00	$27.00	$32.00
3x6 and 8	27.00	27.00	28.00	33.00
4x4-6 and 8	27.00	28.00	29.00	34.00
3x10 and 12	27.00	28.00	29.00	34.00
3x14	31.00	32.00	33.00	35.00
4x10 and 12	27.00	28.00	29.00	34.00
4x14	31.00	32.00	33.00	35.00

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft
6x10	$29.00	$32.00	$34.00
6x14	31.00	34.00	36.00
8x10	29.00	32.00	34.00
8x14	31.00	34.00	36.00

New York, Chicago, St. Louis and Detroit—Wholesale prices to dealers of long leaf yellow pine.

	New York*		Chicago	
	20 Ft. and Under	22–24 Ft.	20 Ft. and Under	22–24 Ft.
3x 4 to 8x8	$38.00	$39.00	$37.00	$39.00
3x10 to 10x10	41.00	42.00	39.00	41.00
3x12 to 12x12	44.00	45.00	41.00	43.00
3x14 to 14x14	47.50	48.50	45.00	47.00
3x16 to 16x16	52.50	53.50	50.00	52.00
3x18 to 18x18	60.00	61.00	56.00	58.00
4x20 to 20x20	70.00	71.00	63.00	65.00

* Wholesale price to dealers; to contractors, on lighters or cars, about $5 additional. Short leaf pine up to 14 x 14 costs $15 per M. less.

St. Louis: Yellow pine, 10@20 ft. long, 3 x 4 to 6 x 6, $20.00; 3 x 8 to 8 x 8, $19; 3 x 12 to 5 x 12, $25; 3 x 14 to 5 x 14, $28; 3 x 16 to 4 x 16, $32; 12 x 14 to 14 x 14, $27; 3 x 10 to 10 x 10, $21; 3 x 18 to 4 x 18, $38; 12 x 16 to 16 x 16, $31.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12 x 12 and under, for sizes over 12 x 12 add $2, for merchantable add $2 to sizes 10 x 10 and under. For pine add $2 to the price of merchantable for all sizes.

Other Cities

	8 x 8-In. x 20 Ft. and Under			12 x 12-In. 20 Ft. and Under	
	P.	Fir	Hemlock Spruce	P.	Fir
Boston	$50.00	$52.00	$55.00 $45.00	$54.00	$52.00
Seattle		20.00			20.00
New Orleans	20.00			25.00	
Baltimore	36.45			38.50	
Cincinnati	39.00	50.00		40.00	64.00
Montreal		47.00	35.00 35.00		47.00
Los Angeles		44.00	43.00		44.00
Denver		33.75	33.75 33.75		34.75
Minneapolis	40.00	38.00	38.00	47.00	37.00
Atlanta	30.00			36.00	
Dallas	33.00			33.50	
Kansas City	33.00	34.00		36.00	35.00
Birmingham	20.00			26.00	
Philadelphia	35.00	36.00	39.00 44.00	44.00	36.00
Detroit	40.00	43.00		45.00	44.00

	1-In. Rough, 10 In. x 16 Ft. and Under			2-In. T. and Gr. 10 In. x 16 Ft.	
	P.	Fir	Hemlock	P.	Fir
Boston	$47.00	$48.00	$32.00	$45.00	$48.00
Seattle		16.00			19.00
New Orleans, at mill	63.00			32.00	
Baltimore	35.00			36.45	
Cincinnati	62.50	80.00		33.50	
Montreal	66.00	48.00	35.00		45.00
Los Angeles		37.00	36.00		65.00
Denver		29.25	29.25		30.25
Minneapolis	38.50	36.25	34.25	36.00	34.75
Atlanta	17.00			21.00	
Dallas	32.00	30.00		36.00	
Kansas City	35.00	34.50		20.00	31.00
Birmingham	18.00			18.00	
Philadelphia	28.00	34.00	40.50	30.00	34.00
Detroit	42.00	33.75		38.50	36.25

Montreal—Up to 32 ft.; over which, $3.00 per M. increase up to 30 ft.

Birmingham—Quotes carload lots, f.o.b. sidings. $2 additional per M. ft. to contractor.

Boston and Cincinnati—Prices to contractors in carload lots, f.o.b.

Denver—Quotes dealers prices to contractor on large projects.

FREIGHT RATES

On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.:

Baltimore	$0.33½	Detroit	$0.32½
Birmingham	.76½	Kansas City	.81½
Boston	.40½	New Orleans	.51½
Buffalo	.29½	New York	.38
Chicago	.38	Pacific Coast (all rail)	1.66½†
Cincinnati	.325	Philadelphia	.35
Cleveland	.24	St. Louis	.47½
Denver	1.35*	St. Paul	.66½

* Minimum carload, 40,000 lb.

†Minimum carload, 50,000 lb., structural steel only; 80,000, lb. for other iron steel products.

CONTRACTORS' SUPPLIES

STEEL SHEETPILING—The following price is base per 100 lb. f. o. b. Pittsburgh, with a comparison of a month and a year ago:

Current	One Month Ago	One Year Ago
$1.75	$1.80	$2.25

WIRE ROPE—Discounts from list price on regular grades of bright and galvanised are as follows:

	Eastern Territory New York and East of Missouri River
Hercules red strand, all constructions	30%
Patent flattened strand, special and cast steel	30%
Patent flattened strand, iron rope	15%
Plow steel round strand rope	45%
Special steel round strand rope	40%
Cast steel round strand rope	32½%
Round strand iron and iron tiller	15%
Galvanized steel rigging and guy rope	17½%
Galvanized iron rigging and guy rope	+2½%

California, Oregon, Nevada and Washington Discount 5 points less than discount for Eastern territory.

Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.

Arizona: Discount 10 points less than discount for Eastern territory.

Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.

North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ¼-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ¼-in., 8 ft., ⅜-in., 6; ½-in., 4½; ⅝-in., 3½; ¾-in., 2 ft. 10 in.; 1-in., 2 ft. 4 in. Following is price per pound for ¾-in. and larger, in 1200-ft. coils:

Boston	$0.20	New Orleans	$0.17½
New York	.17	Los Angeles	.16½
Chicago	.19	Seattle	.16½
Minneapolis	.19½	St. Louis	.18
San Francisco	.17	Montreal	.30
Atlanta	.20	Detroit	.19
Denver	.20	Baltimore	.20
Cincinnati	.20	Kansas City	.18½
Dallas	.29	Birmingham	.20½
Philadelphia	.17		

EXPLOSIVES—Price per pound of dynamite in small lots:

	Gelatin 40%	Gelatin 60%
New York	$0.2950	$0.3250
Boston	.24	.275
Kansas City	.24	.2750
Seattle	.1575	.1875
Chicago	.2450	.2750
Minneapolis	.2144	.2347
St. Louis	.2475	.2775
Denver	.2250	.2550
Dallas	.29	.375
Los Angeles	.23	.26
Atlanta	.2575	.2925
Baltimore	.2550	.27
Cincinnati	.2350	.265
Montreal	.215	.255
Birmingham, delivered	.155	.175
New Orleans	.2725	.3075
San Francisco	.195	.23
Philadelphia	.24	.27

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York.

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.14	$0.19
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	0.18½	0.25
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	0.21	0.27½
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	0.24	0.32½
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	0.26	0.34½
14 in.—2 ft. from butt	5 in.	80 to 89 ft.	0.33	0.42

SCRAP—The prices following are per gross ton paid to dealers and producers in New York. In Chicago and St. Louis the quotations are per net ton and cover delivery at the buyer's works, including freight transfer charges.

	New York	Chicago	St. Louis
No. 1 railroad wrought	$12.00	$11.50	$12.00
Stove plate	12.00	12.00	13.50
No. 1 machinery cast	18.00	16.50	14.50
Machine shop turnings	5.50@6.50	4.00	5.00
Cast borings	9.00@9.50	5.50	6.75
Railroad malleable cast	10.00	12.50	20.25
Re-rolling rails	11@11.50	13.00	15.00
Relaying rails	28.50@29.50	30.00	15.00

SHIP SPIKES—Current prices per 100 lb.:

In	San Francisco Galv.	San Francisco Black	Seattle Black
½	$9.10	$7.40	$8.55
⅝	8.65	6.65	8.25
¾	8.50	6.50	8.30

Pittsburgh base in lots of 200 kegs or more $2.15@2.25